NAVAL POSTGRADUATE SCHOOL
Monterey, California

**Estimating Economic Benefits
of Naval Forward Presence**

by

Robert Looney
David Schrady

October 2000

20001222 112

DTIC QUALITY INSPECTED 4

NAVAL POSTGRADUATE SCHOOL
MONTEREY, CA 93943-5000

RADM David R. Ellison, USN
Superintendent

Richard Elster
Provost

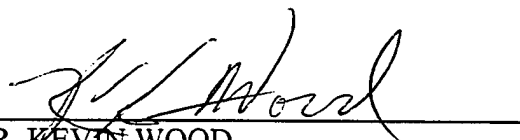This report was prepared by:

_____
DAVID A. SCHRADY
Distinguished Professor of
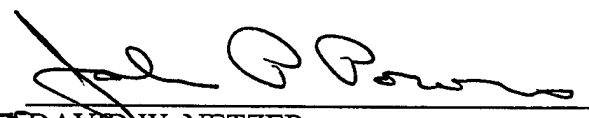Operations Research

_____
ROBERT LOONEY
Professor of National Security Affairs

Reviewed by:

Released by:

_____
R. KEVIN WOOD
Associate Chairman for Research
Department of Operations Research

_____
JAMES N. EAGLE
Chairman
Department of Operations Research

_____
DAVID W. NETZER
Associate Provost and Dean of Research

REPORT DOCUMENTATION PAGE

Form approved
OMB No 0704-0188

1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE October 2000	3. REPORT TYPE AND DATES COVERED Technical

4. TITLE AND SUBTITLE

Estimating Economic Benefits of Naval Forward Presence

5. FUNDING

N0003900WRDR036

6. AUTHOR(S)
David A. Schrady and Robert Looney

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

Naval Postgraduate School
Monterey, CA 93943

8. PERFORMING ORGANIZATION REPORT NUMBER

NPS-OR-01-004

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
Chief of Naval Operations, N816
2000 Navy Pentagon
Washington, DC 20350-2000

10. SPONSORING/MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION/AVAILABILITY STATEMENT

Approved for public release; distribution is unlimited.

12b. DISTRIBUTION CODE

13. ABSTRACT (Maximum 200 words)

This study extends the analysis of the economic benefits of naval crisis response enabled by forward presence undertaken by the Naval Postgraduate School for the 1997 Quadrennial Defense Review (QDR97). That study developed an operational methodology for quantifying these benefits. Drawing on that methodology, significant economic benefits were found associated with naval crisis response in the Arabian Gulf. The current study expands the QDR97 effort in several important directions. First, event analysis is introduced to link naval crisis response with price movements in key commodity, exchange, and share markets. Second, several new cases, one not directly involving oil, are developed to assess the generality of our findings. The findings of the first study are confirmed with naval forward presence/crisis response shown to produce extensive economic benefits for the US economy in each of the cases examined. Taken together, the two studies suggest that the economic benefits associated with naval forward presence/crisis response occur in a wide variety of crisis situations and geographical locations. More importantly, increased globalization together with the revival of tight oil markets will, for the foreseeable future, only reinforce the economic contributions made by forwardly deployed forces.

14. SUBJECT TERMS naval forward presence, economic benefits, econometrics			15. NUMBER OF PAGES 155
			16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT Unclassified	18. SECURITY CLASSIFICATION OF THIS PAGE Unclassified	19. SECURITY CLASSIFICATION OF ABSTRACT Unclassified	20. LIMITATION OF ABSTRACT UL

EXECUTIVE SUMMARY

Over the years, one of the more illusive questions posed to and by the US Navy concerns the economic benefits to the United States and allied countries provided by naval forward presence and the timely crisis response it enables. While most authorities on the subject contend that these benefits are significant, their measurement has always been fraught with conceptual and computational difficulties. The greatest difficulty has always involved developing a convincing counterfactual argument about what the state of affairs would have been in the absence of forward deployed naval forces.

NPS Studies on the Economic Benefits of Naval Forward Presence

Our 1997 study of three cases of naval forward presence and crisis response in the Arabian Gulf suggested that it is possible to design methodologies capable of quantifying the benefits of naval forward presence. More importantly the benefits were shown to be significant in terms of their dollar amounts. This study extends our methodology through: (1) the use of additional statistical analysis, and (2) the development of four new cases of naval forward presence and crisis response. Cases were selected to provide greater geographical diversity and market impact. In addition, care was taken to assure that these cases involved primarily naval units, with at best limited participation from the other services.

- The Taiwan Strait Crisis (1996) was selected because of its importance and also the fact that it did not appear to involve oil markets.

- Operation Desert Strike (1996) was chosen to see if a crisis of very short duration involving naval forces was capable of altering oil markets in a manner that resulted in a significant impact on the United States economy.

- Operation Desert Fox (1998) was selected because it represents a case where there was great uncertainty in oil markets concerning both Iraq's intentions and the consequences of naval actions.

- Libyan Operations (1986) was chosen because it occurred at a time in which oil markets were first developing sophisticated forward markets. Also represents a case close to Europe and thus possible links to exchange and share markets.

Main Findings

The study produced a number of significant findings:

- As in the first study, all cases are shown to produce positive economic benefits for the United States economy. These benefits, measured in 1995 US dollars, are non-trivial with each operation yielding well over a billion dollars in terms of added Gross Domestic Product to the US economy.

i

- Also similar to the first study, the oil markets provide a consistent link between naval actions and the US economy. This occurs despite the fact that in one case, the Taiwan Strait incident of 1996, it is not apparent that oil markets would be affected.

- While oil markets were the one constant throughout the cases, several other markets are affected by naval actions. These include: the dollar/yen exchange rate, the CRB commodity index, the Goldman-Sachs Commodity Index, the S&P-100, the NIKKEI 225, the Hang-Seng, and the New York Stock Exchange Composite Index.

- More importantly, naval actions have a positive effect. In each case involving oil, naval actions reduce the price from what it would have been in the absence of forward presence and crisis response. In the case of share markets and the dollar/yen exchange rate, prices are higher than they would have been if naval forces had not been present.

- In affecting these markets, naval actions are shown to produce a short-run (overnight effect) in the directions noted above. More importantly the analysis found that the impact of naval actions on these markets lingers for a significant time, altering prices for a period of time that allows for significant benefits to the United States economy.

- With regards to globalization, naval actions are seen to complement the positive impact that increased globalization has had on the US economy. In addition, it is argued that naval forward presence and crisis response tended to strengthen the process of globalization through providing stability and security for markets.

Summary and Implications

Summing up, the study's findings confirm and reinforce our original findings as to the significant and positive economic impacts associated with naval forward presence and crisis response. We have now examined seven cases and in each found benefits of at least a billion dollars (over $50 billion in the Gulf War) to the United States economy. Furthermore, these effects were found to occur in a variety of situations and over a long period of time. More importantly the statistical findings presented here confirm many of the educated guesses made in that earlier study concerning the links between naval actions, markets and the US economy.

As for the future, these findings combined with likely developments in oil, securities and foreign exchange markets, together with trends in globalization suggest that the Navy's forward presence is more than likely to produce similar if not increased economic benefits to the United States economy in the years to come. Increased integration of markets should aid in transmitting the Navy's stabilizing effect on markets, while naval presence should aid in speeding up the process of globalization, which in and of itself is providing significant benefits to the US economy.

ACKNOWLEDGMENTS

Table of Contents

I. Introduction

Over the years one of the more illusive questions posed to and by the Navy concerns the economic benefits to the United States and allied countries provided by U.S. Naval forward presence. Forward presence enables timely crisis response. While most authorities on the subject contend that these benefits are significant, their measurement has always been fraught with conceptual and computational difficulties. The greatest difficulty has always involved developing a convincing counterfactual argument about what the state of affairs would have been in the absence of timely crisis response by forward-engaged naval forces.

I.1 Background

The issue came to the fore in preparing for the Congressionally-mandated 1997 Quadrennial Defense Review (QDR). Early in the QDR preparations, Navy leaders asked if the economic benefits of forward-engaged naval forces could be quantified and thereby communicated to policy makers. Until this point, the only evidence of such benefits was anecdotal (System Planning Corporation 1996). The Naval Postgraduate School was tasked to develop new methodologies directed toward the quantification of these benefits.

The methodology ultimately developed focused on the effect of naval forward presence and crisis response on world oil prices, as reflected by oil futures markets (Naval Postgraduate School 1997). Using a vector autoregression econometric model, the approach then linked the oil price effects associated with naval forward presence and crisis response to changes in major economic indicators.

I.2 Findings in the Previous Study

This methodology was then applied to three cases of naval crisis response: the opening stages of Desert Shield (1990 Gulf War); the Iraq-Kuwait border incident of October 1994; and the January 1987 Gulf Shipping Crisis. These crises varied in terms of the military threat posed to U.S. and allied interests, oil market conditions, business cycles and the general world economic climate, but a clear trend emerged from the analysis of each incident. When oil futures markets become aware of naval crisis response, oil prices decline.

By stabilizing and lowering prices in oil futures markets during these crises, naval crisis response provided significant benefits to the U.S. economy. These benefits are measured in terms of dollar losses that would have occurred in the absence of naval crisis response. Conservative estimates indicate that naval crisis response in the opening stages of Desert Storm provided $55.22 billion (1997 dollars) worth of economic benefits (Gross Domestic Product, GDP) to the United States. Similarly, naval crisis response during the 1994 Iraq-Kuwait border incident yielded $7.13 billion (1997 dollars) in benefits, while naval crisis response during the 1987 Gulf Shipping Crisis produced $5.01 billion (1997 dollars) in benefits. Naval crisis response not only had a positive impact on the U.S. economy, but also on the economy of America's allies. Naval crisis response in the opening states of Desert Storm alone is likely to have provided up to a $86.80 billion (1997 dollars) increase in world income (GDP).

To summarize, several major findings emerged from this research:

1

- Most important, it is possible to develop procedures to quantitatively measure some of the economic impacts of naval crisis response.

- Economic impacts can be measured in terms of dollar cost savings and or additional dollar resources available to the economy.

- These economic impacts can be significant. They may also persist over a fairly long time period and across the economies of a large number of US allies.

- While these initial estimates of the economic benefits associated with naval crisis response are high, it is apparent that they underestimate the complete benefits associated with crisis response. One can simply not put a hard figure on the benefits from the many crises no doubt prevented by the mere forward presence of the Navy.

The study concluded that economic benefits associated with naval forward presence in the Gulf region would most likely outweigh the costs associated with these operations. Albeit without hard analysis, it was concluded that in the future, given the nature of oil markets, naval forward presence probably would continue to yield significant economic gains.

The FY97 study has been widely circulated and critiqued, and the economic analysis described above has been well received. The methodology developed and applied to the Desert Storm case has been accepted for publication in the professional peer-reviewed academic journal Interfaces.

1.3 Relevance for the Current Study

As is the case with most first attempts, the NPS Report has distinct strengths and weaknesses. The strength of the analysis lies in its analytical methodology linking naval crisis response to movements in oil futures prices. This linkage creates a credible counterfactual argument of what oil prices would likely be in the absence of naval intervention. While there are still several conceptual problems to be resolved (mainly relating to other factors that might influence oil prices), these linkages have withstood detailed scrutiny. The weaknesses of the study include a relatively small sample of cases taken from one, albeit important, region of the world. In addition, given time constraints, other markets (exchange rates, commodity markets and the like) that might also have been affected by naval movements (thus providing additional benefits to the U.S. economy) were not systematically examined.

The current study was undertaken to address these limitations while, at the same time strengthening, and extending our basic methodology. Specifically in the first study:

- The links between naval movements and oil prices were largely inferred from the movements in oil spot rates together with movements in the gap between the first and second forward contract (a standard measure of the market's assessment of risk). While this approach is on solid theoretical ground, one might argue that one or more other events associated with the crisis were responsible for these price movements. To overcome this limitation, the current study takes all of the events (naval and non-naval) surrounding a crisis and tests them econometrically to determine their statistical association with oil prices.

- Event analysis is also used to test different hypotheses concerning the market's response to announced naval movements. Specifically we test the alternative view commonly held that naval movements generate concern over potential conflicts in a region, thus precipitating oil price increases. That hypothesis is conclusively shown to be false.

- While the earlier study found strong linkages between naval movements and oil prices, one might argue these associations were simply overnight effects. Given the volatility of commodity markets, naval crisis response impacts could be quickly reversed thus producing little in the way of a long-term impact on economic activity in the United States. While our use of forward markets overcame this criticism, we have extended the analysis even further in an attempt to statistically verify the existence of long-run price movements resulting from naval crisis response.

- To this end, the current study uses a relatively new econometric technique, cointegration analysis, to test for long-run associations. Specifically, is there an association between naval events and markets that tends to modify the movement of prices over long periods of time? Are these periods sufficiently long so that naval events have a significant impact on economic activity in the United States? The analysis clearly shows that both are the case.

- As noted above, given time limitations, the initial study focused exclusively on oil markets. Certainly there are number crises in regions where oil markets are not seemingly involved. The issue is whether there are other markets or indirect effects on oil markets that naval events might impact that are capable of ultimately producing non-trivial benefits for the US economy? The current study extends the first by systematically introducing other commodity markets, exchange rates and share markets into the analysis.

- The cases in the original study were all drawn from the Arabian Gulf. Here the issue is whether or not this biased the conclusions drawn. Is the Gulf unique to the extent that few generalizations can be drawn for other parts of the world? To address this issue several cases outside the Gulf were selected: the Taiwan Strait crisis of 1996 and the Libyan crisis of early 1986.

- Finally, the first study focused on individual cases without assessing the extent to which changing world economic conditions, globalization and the like might alter the outcome if similar events occurred in the future. To overcome this limitation the current study examines the links between naval forward presence and crisis response, and globalization. The issues examined include whether current trends in globalization strengthen or weaken the economic impacts associated with naval forward presence and crisis response? Does naval forward presence affect the economic environment associated with a particular state of globalization? Are naval forward presence and likely changes in globalization likely to aid or stifle economic growth in the United States?

As noted, the current study examines four additional cases to assess the extent to which the findings of our first study can be generalized. The cases were chosen to provide greater geographical diversity. In addition, care was taken to assure that these cases involved primarily naval units, with at best limited participation from the other services.

3

- The Taiwan Strait Crisis (1996) was selected because of its importance and also the fact that it did not appear to involve oil markets.

- Operation Desert Strike (1996) was chosen to see if a crisis of very short duration involving naval forces was capable of altering oil markets in a manner that resulted in a significant impact on the United States economy.

- Operation Desert Fox (1998) was selected because it represents a case where there was great uncertainty in oil markets concerning both Iraq's intentions and the consequences of naval actions.

- Libyan Operations (1986) was chosen because it represented a time in which oil markets were first developing sophisticated forward markets. Also represents a case close to Europe and thus possible links to exchange and share markets.

The next chapter describes the methodology developed in this study. That methodology is then applied to the analysis of the four cases described above. Chapter VII examines globalization and naval forward presence. A summary of the study's principal findings is provided in the final chapter.

II. Methodology

II.1 Introduction

The methodology used in the current study draws on and extends that developed in our earlier work (Naval Postgraduate School 1997). The main difficulties in estimating the economic benefits derived from naval forward presence and crisis response is in establishing a credible counterfactual argument as well as a meaningful measure of impact. Specifically, what would have been the state of the United States economy if naval forces had not responded to the crisis at hand? Given that naval forces did respond, what is the relevant measure to capture the economic impact associated with this response?

II.2 Conceptual Issues

Both problems are fraught with a number of conceptual issues that need to be resolved before the calculation of economic benefits can be undertaken. First, by their nature, crises tend to have a negative impact on markets and economic activity. Forward-engaged naval forces are often the first to respond to a crisis and their arrival on scene usually has a stabilizing political influence. The stabilizing influence extends to economic activity as well. As noted in the Introduction and based on our first study, oil appears to be the most tractable vehicle for analyzing the economic benefit of naval forward presence and crisis response. Because oil is essential to nearly all-economic activity in the industrialized world, price movements of that commodity in reaction to world events provide a useful index of the overall economic impact of international crises, and of the response of naval forces to them.

Second, it is essential to select an index capable of reflecting the market's interpretation of the severity of a crisis as well as the degree to which trader confidence is restored following the response of naval forces to a crisis. Because oil futures prices provide more information than spot prices, this study uses futures prices to explore the effect of naval forward presence and crisis response. Oil futures markets serve as an efficient substitute for the bulk storage of oil. Instead of stockpiling oil reserves, futures markets such as the New York Mercantile Exchange (NYMEX) allow companies to purchase contracts to buy or sell oil at some future time. These contracts are transacted for individual months in the future. Traders base their offers on the best economic, political, and military information available to them at the time the contract is traded. As a result, futures prices are considered to be the best-unbiased estimate of the likely spot or daily price of oil when the contracted delivery date actually arrives [Bopp 1991].

II.3 The Use of Futures Markets

Futures transactions generate oil price forecasts that reflect traders' confidence that oil will be readily available at some future point in time. Futures prices can thus be used to assess the effects of naval forward presence and crisis response on market confidence in oil availability. Perhaps more importantly for purposes of this study, the use of futures markets allows the effects of naval crisis response on oil markets to be isolated from those caused by other events.

The broad outline of the study methodology is to track futures oil prices, observe the increase in prices caused by a crisis and the reduction and stabilization of the prices when naval forces arrive on scene. This generates an estimate of the value of the crisis response of naval

forces in terms of the price paid for oil. Furthermore, when used as an input to econometric models, futures prices can be used to compute the long-term effects on economic activity in the United States and other world economies.

II.3.1 Identification of Market Anticipations

The notional pattern is assumed to be as follows. Prior to a crisis, oil futures market curves generally slope upward as shown in Figure 1, Curve 1. Curve 1 reflects both the cost of storage and the general expectation among traders that oil prices will increase over time. With the advent of a crisis, however, future availability of oil is in doubt and traders attach an uncertainty premium to there ask price [Gabilon 1995]. The effect on futures prices is twofold. First, such a development increases futures prices for all months (indicated by an upward shift in the futures price schedule).

Figure 1

Notional Relationship Between Naval Crisis Response and Oil Futures Markets

Months Until Contracted Delivery
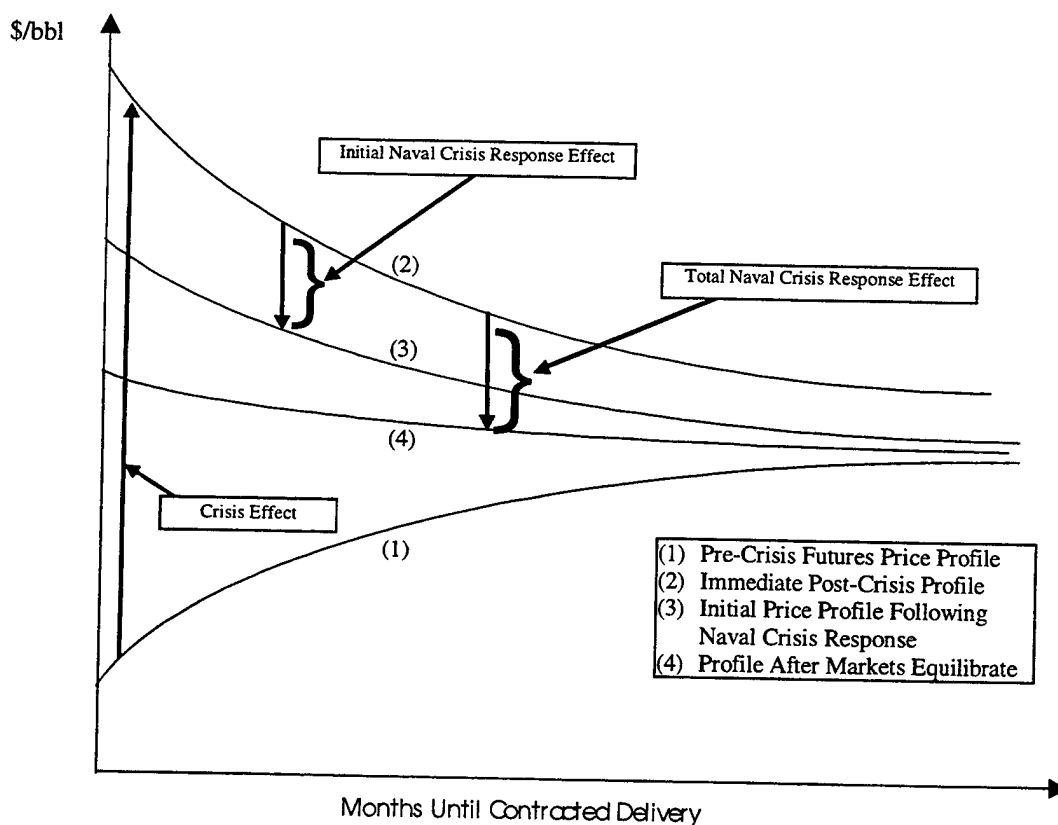
Second, the slope of the futures market curve becomes negative (Figure 1, Curve 2), reflecting traders' willingness to pay a premium for immediate possession of oil. When naval forces respond to the crisis, some of the uncertainty concerning oil supplies is alleviated, which shifts the futures price curve downward and decreases the short-run premium paid for immediate

6

possession of oil. These effects are evidenced by a downward shift and flattening of the futures price schedule (Figure 1, Curve 3). Over time, naval forward presence reduces risk to oil supplies and alleviates traders' concerns over oil availability. Increasing confidence in oil supplies can be seen graphically by a further flattening of the futures price curve (Figure 1, Curve 4).

II.3.2 Calculation of Economic Benefits

In the analysis that follows, futures prices are used to compute two different measures of the benefits derived from naval crisis response. First, potential savings in oil import bills alone are estimated by multiplying the differential between the higher prices caused by the crisis and the prices moderated by naval crisis response by the amount of oil imported during the period that begins with the onset of the crisis and ends when markets stabilize. A second, far larger measure is the effect of lower oil prices over time as they spread through the economy affecting production, employment, inflation and more.

These much larger effects on economic activity in the United States and other world powers are estimated through the application of a class of econometric models originally developed by Christopher Sims of Northwestern University in the early 1980s [Sims 1980]. In Figure 2, the box labeled 'Vector Autoregression Econometric Model' (VAR) refers to a model for the United States economy developed for the current study along the lines of the original Sims' estimation framework. The short-term oil price effects associated with naval crisis response are the difference between curves 2 and 3 in Figure 1, and they become part of the input data for Sims' model to estimate short-term economic benefits. For long-term economic benefits, the difference between curves 2 and 4 in Figure 1 is used instead, since curve 4 represents the futures prices after a new equilibrium has been established.

Summing up, the actual steps used in computing the economic benefits of naval crisis response are outlined in Figure 2. Using the various NYMEX oil future prices from Figure 1 as inputs to the model of the United States economy (VAR), the likely level of GDP and key components under each set of prices is calculated. The differential between the resulting GDP scenarios (based on the sets of prices noted in the previous paragraph) is interpreted as the effect (avoidance of lost income/GDP) brought about by the naval crisis response.

When compared with an examination of oil spot prices, the methodology developed here, which is based on futures prices, better captures the true effects of naval forward presence and crisis response. Relying solely on spot prices may lead to a conclusion that naval forces produce a price effect that is only temporary and of little economic significance. In reality, naval forward presence and crisis response alters key price structures months into the future. Because oil futures prices, as used in this analysis, provide considerably more information about the response of oil markets to naval activity than do spot prices, this methodology captures larger, longer-term economic benefits of naval crisis response. With the methodology in place, it is applied to a specific crisis.

7

Figure 2

**Methodological Overview: Steps in Computing the Economic Benefits
Derived from Naval Crisis Response**
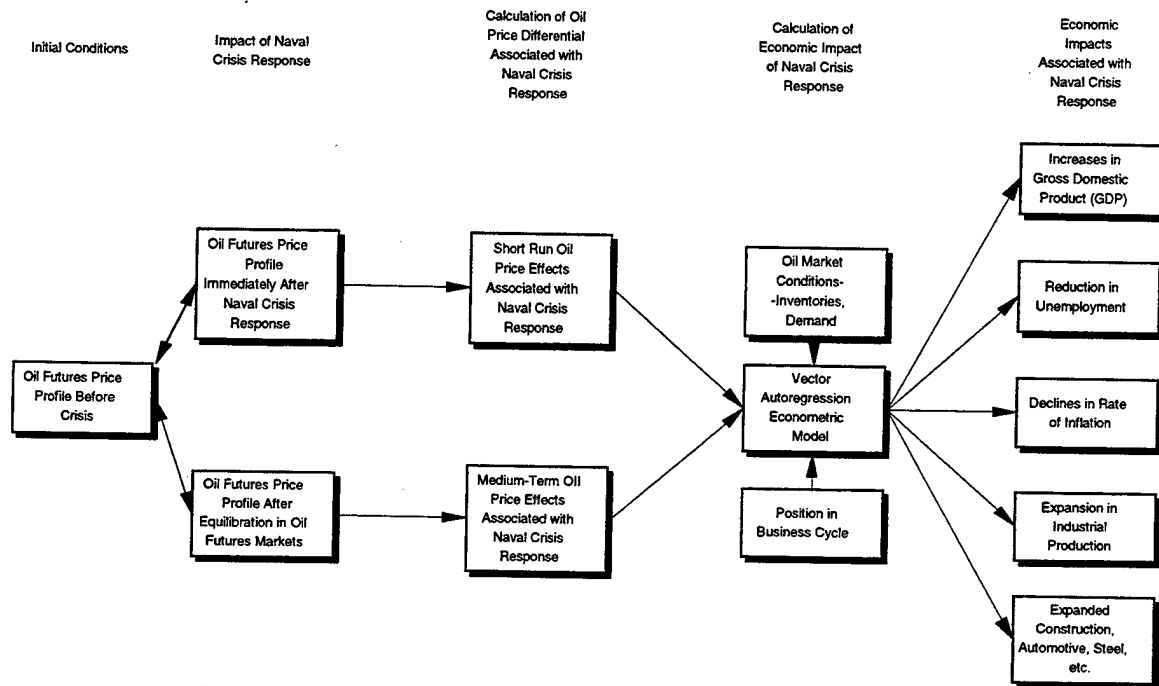
II. 4 Model Extensions in Current Study

The steps noted above comprised the core of the approach used in our initial study and provide the key building blocks for the current effort. Specifically, the present study extends this approach in several key areas. Using the method outlined above one still has great difficulty in making a convincing argument that changes in oil prices or other key economic variables during a period of crisis were due in large part to the movement of naval forces from forward presence positions. Even though in our earlier cases in the Gulf a clear pattern seemed to exist between crisis response and oil price movement, the strongest arguments making this link had to rely largely on the process of elimination; i.e., no other credible events could have produced the observed pattern of oil prices.

A second problem is that naval forward presence and crisis response analysis has focused almost exclusively on oil markets. Clearly however, other markets concerned with safety of supplies, access to raw materials, future economic conditions and the like must also be affected to one extent or another by the movement of naval forces at critical junctures. To overcome these limitations the current study incorporates several new elements:

8

II.4.1 Additional Markets

With increased globalization and the increased interlinking of markets, it is clear that naval actions are likely to affect exchange rates, share values, and a whole host of related commodity indexes. Associated movements in these markets are also likely to impact on the US economy. Specifically, associated movements in one or more of these markets may enhance the positive impacts of naval actions or, conversely, offset the oil derived benefits. For example although naval crisis response often lowers oil prices, it may simultaneously weaken the yen, providing Japanese exporters with a competitive edge in the US market. Subsequently, increased imports and associated loss of jobs could conceivably offset all of the benefits derived from lower oil prices.

The current study therefore extends the basic oil model outlined above by incorporating movements of several key foreign exchange rates (the forward values of the yen, mark and pound) into the analysis. Also included are several key commodity futures indexes, the CRB commodity index and the Goldman-Sachs commodity index. Finally, several key share markets, the New York Stock Exchange Composite Index, the S&P100, the FTSE, the Nikkei and the Hang Seng are also included in the analysis.

II.4.2 Event Analysis

The second major extension of our earlier model was to design a method for statistically linking naval actions and other events to price movements in key markets. As noted above, our earlier study made this key connection largely through the process of elimination. Event analysis provides a true statistical test of the association of naval actions and markets. It also can be used for hypothesis testing. Specifically, do naval actions increase market uncertainty or do they provide a stabilizing impact? Do naval actions produce only a transitory movement in market prices or are these actions responsible for longer run adjustments in these markets? If the latter is the case, the credibility of the forward market analysis outlined above is strengthened in that the consequences of naval actions are not confined to the short-run up-and-down fluctuations of spot prices. Instead, these actions actually set in motion a whole series of economic adjustments that, taken as a whole, provide significant economic benefits.

Basically, event analysis consists of coding events (actions, key developments) with a subjective evaluation of their likely consequences. In this study we have used a scale of –3 to +3 to characterize individual actions. For example if events clearly relieve tension and reduce the chance of open conflict in the region, they would be given a score of –3. On the other hand, provocative incidents would receive a +3. If it is unclear what the consequences of an event might have been, several hypothesis can be tested. In short, rather than speculating as to the manner in which markets actually perceived the event, alternative specifications can be tested to determine which scoring system best depicts the manner in which markets reflected the significance attributed by traders to naval and non-naval events.

For example, in the Taiwan Strait case examined below, naval forces account for two important events—December 19, 1995 when the USS Nimitz Battle Group crossed the Taiwan Straits for the first time since 1979 and March 22, 1996 when the USS Nimitz Battle Group again arrived in the vicinity of Taiwan. One school of thought contends that both events heightened tensions in the region, thus elevating oil and other affected market prices. Another school of

thought contends that both events, by showing US resolve to defend Taiwan actually defused tensions, thus causing a drop in affected prices. Using both positive and negative signs for these two dates one can statistically test for the interpretation that best fits the facts. For the case at hand, it is clear from the analysis below that the second interpretation is the correct one.

Statistically, several regression-type techniques can be used to conduct an event analysis. The ones chosen here are described at length by Pesaran & Pesaran (1997). The first technique, the Cochrane-Orcutt iterative procedure, is used to compute maximum likelihood estimators under the assumption that the regression disturbances follow an autoregressive (AR) process. This particular procedure is useful because it corrects for serial correlation (correlation of the error terms), thus producing superior estimates to those usually associated with least-squares regression. This technique is used to assess short-run movements that clearly do not have a long-run component. For example several tests are undertaken to determine which events (naval or non-naval) are responsible for the uncertainty in key markets as measured by the spread between the first and second contract (the contract for oil to be delivered next month and the contract for the second month from now). Do naval events create uncertainty thus increasing the spread, or do they provide stability and assurance of supplies thus reducing the spread?

II.4.3 Shock and Long-Term Adjustment Analysis

To test for long-run associations between naval actions and key markets we adapted Pesaran & Pesaran's autoregressive distributed lag (ARDL) approach to cointegration. This technique has been applied (Looney 2000, Looney and Frederiksen 2000) to a wide variety of research problems involving shocks and longer run adjustments. If two variables, say the NYMEX oil price and Brent oil price, establish a long-run pattern with each other they are said to be cointegrated. Short-run shocks can disrupt the pattern. However these shocks simultaneously set off an adjustment process restoring the historical pattern. For example if there was a long-run pattern between the NYMEX and Brent markets, a sudden jump in the Brent price due perhaps from a disaster in the North Sea, prices in the NYMEX market would gradually increase to restore the original longer-run pattern.

In our example, oil prices on any one date can therefore be said to reflect two forces—the long-run adjustment to a normal pattern and a short-run movement in response to an event shocking the system. Technically, any change in price will reflect, to one extent or another, these short and long-run components.

II.4.3.1 The ARDL Approach to Cointegration

The autoregressive distributed lag (ARDL) approach to cointegration is used extensively below for several reasons. First, the procedure establishes a fairly strict and unambiguous set of criteria for selecting the appropriate lag structures. Specifically, the analysis embodies several summary statistics that can be used to determine if the appropriate lag between an event and its impact is one, two or even more days. This useful feature takes a lot of the guesswork out of relying on visual charts to determine the pattern. Second, the technique allows us to go beyond the day-to-day fluctuations in prices to assess the longer-term ripple effects associated with a crisis. Clearly, if an event increases prices one day and in turn prices fall the next, the event may appear to have little consequence in terms of economic costs or benefits. On the other hand if this shock carries over to a series of longer-term adjustments, the event can have considerable costs (or benefits). The ARDL approach was designed to identify the occurrence of this type of phenomenon.

10

II.4.3.2 An Example

These points can be best illustrated with a typical example from one of the cases. Using the timeline from the Taiwan Strait case, naval and other events over the period from December 1, 1995 to April 2, 1996 are coded on a scale of +3 to –3 (Appendix B) depending on their anticipated impact on NYMEX oil prices. Here, several sets of codes are logical. EVENT3 assumes a favorable response (downward pressure on oil prices) from each of the naval events.

As a basis of comparison and hypothesis testing, the series, EVENT3A, is constructed on the assumption that the initial naval event on December 19 destabilized oil markets (resulting in a price increase that day). However, the March 22, 1966 event involving the Nimitz retained its value of (-3). In constructing the series EVENT3B, both naval events receive a positive score on the hypothesis that markets treated these events as the prelude to increased tension and uncertainty. Finally, in constructing the scores for EVENT3C, all events, naval and non-naval receive a positive score on the assumption that they destabilize oil markets.

To determine which set of assumptions (EVENT3, EVENT3A, EVENT3B or EVENT3C) best depicts the manner in which oil market traders interpreted the events during this period, the ARDL regression formulation noted above was undertaken four times (one for each of the EVENT series). The outcome when EVENT3 set of assumptions was assumed to be the relevant depiction of market sentiment produced an equation of the form:

$$(1)\ \Delta NYMEXS = -89.8\ \Delta INTP + 0.7\Delta BRENTS + 13.5\ \Delta EVENT3(-1) - 0.6\ ecm(-1)$$
$$\qquad\qquad (-1.06) \qquad\quad (6.29) \qquad\quad (2.33) \qquad\qquad (-6.37)$$

where NYMEXS is the NYMEX spot rate, BRENTS is the Brent spot rate, EVENT3 is the various naval and non-naval events from the time line, INTP is the intercept term and ecm is the error correction mechanism. Δ is the variable's change from the previous period and (-1) is the variable lagged one period. Terms in parentheses below the equation are the t-ratio (regression coefficient divided by the standard error) for the associated variable. The t-ratio for each variable indicates that all variables except the equation intercept term ($\Delta INTP$) are statistically significant at the 95% level of confidence. The ecm term itself has the form:

$$ecm = NYMEXS + 155.4 INTP - 1.1 BRENTS - 23.37\ EVENT3$$

The equations are interpreted as follows.

• During this period the NYMEX market formed a long-run pattern with the BRENT market and the EVENT3 term (evidenced by the statistical significance of the ecm term).

• In the short-run, movement in either the BRENT or EVENT3 term set off a shock that disrupted the long-run pattern of the three variables.

• In this example, naval events have a negative sign (assumed to reduce oil prices) in the ecm. It follows that a naval event would lower oil prices in the short-term (given the positive sign on the EVENT3 term).

11

- Following a shock (that, for instance, raises the price of oil in the short-run), the ecm term (with its negative sign) begins to pull that price downward until its long-run pattern with the other two variables is restored.

- The speed of this adjustment is proportional to the gap between the NYMEX, Brent markets and the EVENT3 term (the negative signs on the Brent and EVENT3 terms in the ecm). The coefficient on the ecm term controls the speed of adjustment with 0.6 being a relatively large term (the term varies from 0 to 1).

- Since naval events have a negative sign in the EVENT3 term and that term in turn has a negative sign in the ecm, naval events increase the size of the ecm term.

- In turn, the ecm has a negative sign in the NYMEXS equation. Naval events therefore are seen as an element that tends to reduce NYMEX prices over time.

Summing up the Taiwan Strait example, the event variables are designed to vary largely based on the weights attached to the two major naval events: the first was on December 19, 1995, when the USS Nimitz Battle Group crossed the Taiwan Straits for the first time since 1979 and the second was on March 22, 1996 when the USS Nimitz Battle Group again arrived in the vicinity of Taiwan. In the EVENT3 variable, both naval events have negative signs (-2 for the first and –3 for the second). Here, the hypothesis is that each would have a stabilizing effect on oil prices, lowering the spot and forward rates. Event variable EVENT3A changes the December 19 naval event to +2 (leaving March 22 at –3), while event variable EVENT3B assigns +2 and +3 to the respective naval events; i.e., naval events would contribute to the increase in oil price. In EVENT3C all of the event variables, naval and non-naval, have a positive sign.

Based on these event codings, the results for the all the event variables are shown in Table 1. Note that the statistical significance of the event variable (as indicated by the t-ratio) declines as we move from the assumption that naval actions stabilize markets to the assumption that naval actions increase uncertainty and destabilize markets. The assumption that all events, naval and non-naval, destabilize oil markets (EVENT3C) has the lowest statistical significance of the four depictions. Given the sample size and degrees of freedom, any t-ration value over 2.0 (absolute value) is significant at the 5% level. These results are consistent with the hypothesis that naval events played a stabilizing, rather than destabilizing, role in oil markets during this particular crisis.

II.5 Conclusions

The methods used to extend our earlier research on the economic effects of naval forward presence should lend increased credibility to that approach. While theoretically correct, our earlier work still relied on several subjective assessments at critical steps. These limitations have been addressed through the inclusion of additional markets and regions, as well as the rigor of event analysis and the econometric assessment of short-run event shocks and longer-run market adjustments.

Table 1

Taiwan Strait Crisis: Impact of Naval Forward
Presence and Crisis Response on the NYMEX Spot Oil Price—Summary

ARDL(1) Regression Results
Dependent variable is the NYMEX Oil Spot Rate (NYMEXS)

Regressor	Coefficient	Standard Error	t-ratio[Prob]
EVENT3(-1)	13.5	5.8	2.33[.022]
EVENT3A(-1)	13.2	5.9	2.25[.027]
EVENT3B(-1)	10.5	6.1	1.73[.089]
EVENT3C(-1)	3.4	6.6	0.52[.603]

Estimated Long-run Coefficients using the ARDL Approach
Dependent variable is NYMEXS

Regressor	Coefficient	Standard Error	t-ratio[Prob]
EVENT3(-1)	23.4	10.5	2.22[.029]
EVENT3A(-1)	22.8	10.5	2.16[.034]
EVENT3B(-1)	18.3	11.0	1.67[.100]
EVENT3C(-1)	6.1	11.7	0.52[.605]

Error Correction Representation for the Selected ARDL Model
Dependent variable is ΔNYMEXS

Regressor	Coefficient	Standard Error	t-ratio[Prob]
ΔEVENT3(-1)	13.5	5.8	2.33[.022]
ΔEVENT3A(-1)	13.2	5.9	2.25[.027]
ΔEVENT3B(-1)	10.5	6.1	1.73[.089]
ΔEVENT3C(-1)	3.5	6.6	0.52[.603]

Notes: Autoregressive Distributed Lag Estimates ARDL(1) with Δ = change from previous period; (-1) lagged one period; Coefficient = unstandardized regression coefficient. The results are presented in three representations; (1) the standard regression presentation; (2) the long-run coefficients; and (3) the error correction format.

III. Case I: The Taiwan Strait Crisis of March 1996

III.1 Introduction

In March 1996 the most serious confrontation in the Taiwan Strait since the 1958 Kinmen crisis occurred. China deployed some 150,000 troops in Fujian Province bordering the strait, and conducted three consecutive military exercises in the areas near Taiwan. These included missile tests close to Keelung and Kaohsiung, Taiwan's two most important seaports; a live-ammunition military exercise, and a large-scale amphibious landing exercise.

Taiwan was on high alert during this period. The United States became involved immediately, sending two aircraft carrier battle groups to the area near Taiwan to monitor Chinese military actions. This was the largest naval movement by the United States in the Asia-Pacific region since the Vietnam War (Porch 1999).

These actions constituted the first potential military confrontation between the two countries since the normalization of relations after President Nixon's visit to China in 1972. Cross-strait tension rose quickly and dramatically and there was widespread fear that China's military exercises might turn into military actions against Taiwan or that accidents might trigger conflict in such a tense situation.

III.2 Timeline

The main events of the crisis are as follows:

August 23, 1995
Lee Teng-hui announces his candidacy for president in the March 1996 election. Beijing's Xinhua (New China) News Agency calls on "all the Chinese people" to sweep Lee "into the dustbin of history."

December 19, 1995
USS Nimitz battle group crosses the Taiwan Straits for the first time since 1979.

January 23, 1996
The New York Times reports China plans to attack Taiwan after the island's presidential elections March 23. China has no comment on the report.

January 24, 1996
Beijing denies the New York Times report that Beijing has completed plans for a limited military attack on Taiwan. A Foreign Ministry spokesman dismisses the report as "totally groundless" and declines to comment further.

February 9, 1996
China begins moving about 150,000 troops to a coastline facing Taiwan. China also reinforces its air strength with 88 warplanes to reach a total number of 226 aircraft deployed at 11 airports along 250 miles of coastline in its southeastern Fujian Province. They also deploy four amphibious landing craft -- two in the Fujian port of Xiamen (3.75

14

miles from the Taiwan-controlled island of Kinmen) and two at Pingtan (island near Taiwan-controlled Matsu island).

February 12, 1996
Taiwan's Defense Ministry says China is massing up to 150,000 troops for large-scale exercises near Taiwan.

February 23, 1996
Taiwanese presidential candidate Peng Ming-min warns China that if it occupies so much as one inch of Taiwan's territory, he will immediately formally declare Taiwan's independence.

February 28, 1996
The U.S. Export-Import Bank complies with Secretary of State Warren Christopher's request to stop financing any deals in China over the next 30 days while the Administration decides whether it will impose sanctions against Beijing for selling nuclear technology to Pakistan.

March 5, 1996
China's official Xinhua News Agency reports that the People's Liberation Army will stage a series of missile exercises just off Taiwan's coast from March 8 to 15. Xinhua says the training exercises will involve surface-to-surface missiles in two areas: one site northeast of Taiwan, about 21 miles from Keelung port, the other 32 miles west of the southern port of Kaohsiung. By using two sites 250 miles apart, China apparently wants to show it can coordinate a complex, large-scale operation and block Taiwan's ports. Foreign ships and aircraft are advised to stay clear of the test sites. The 40-member House Republican Policy Committee issues a written statement rejecting the Clinton Administration's ambiguity on the question of whether the US would defend Taiwan if it comes under attack from China. The statement says the US should commit itself "to the defense of Taiwan" and work to deter China from "invading, attacking, or blockading Taiwan."

March 8, 1996
At intervals of roughly an hour, three M-9 ballistic missiles carrying dummy warheads splash down into target areas just 22 miles from Keelung, the island's second busiest seaport, and 32 miles from the harbor of Kaohsiung, the third largest container port in the world. These two ports are the closest to the Chinese target zones, and account for 70 percent of Taiwan's two-way trade. China also stages elaborate military maneuvers in a 6,600-square-mile rectangle that stretches to the mid-point of the Taiwan Strait. The area is 30 to 70 miles from Taiwanese Islands. Beijing also says it plans to begin "live ammunition" war games on March 12 in a 6,000-square-mile zone that will obstruct much of the shipping and air traffic in the Taiwan Strait.

March 9, 1996
China's People's Liberation Army announces live-fire naval and air force exercises at the south end of the Taiwan Strait from March 12-20.

March 10, 1996
U.S. Secretary of State Warren Christopher calls China's attempt to intimidate Taiwan "reckless," and announces the dispatch of a battle group led by the USS Independence. He says, "I think they've been risky, and... smack of intimidation and coercion." The

destroyer USS Hewitt and guided-missile frigate USS McClusky will join the Independence north of Taiwan the following day, according to the Seventh Fleet from Yokosuka, Japan. The guided-missile cruiser USS Bunker Hill takes up a position south of the island to monitor China's missile tests, according to the Navy. Secretary Christopher says on NBC's Meet the Press that the U.S. intends the warships to be "in a position to be helpful, if they need to be."

March 11, 1996
1996 President Clinton orders a second US carrier battle group into the area, and the Pentagon shifts a carrier already there closer to Taiwan. The naval battle group led by the USS Independence, stationed about 200 miles off Taiwan's shores the week before to monitor China's ballistic missile exercises, has moved to within about 100 miles. It remains outside the Strait of Taiwan. Secretary of Defense William Perry says the movement of U.S. warships is "a prudent, cautionary measure."

March 12, 1996
China launches war games southwest of Taiwan, drawing a Taiwanese threat to strike back if the mock warfare turns into an attack. Chinese combat planes and warships practice bombing runs and drills off Taiwan at the start of eight days of war games. About 10 Chinese ships conduct formation drills, and about 10 warplanes practice air cover, surveillance and bombing runs near Dongshan and Nan Ao, on China's southeastern coast. Taiwan places its 400,000-member military on heightened alert, especially on the islands that face the exercise area.

March 13, 1996
China fires another missile near Taiwan, but unlike the others, this one does not cross Taiwan's territorial waters. The missile was an M-9 intermediate-range missile.

March 14, 1996
A key House panel Thursday approves a non-binding resolution urging the United States to intervene militarily if Taiwan is attacked, invaded, or blockaded by mainland China. In a voice vote, the House International Relations Committee passes the measure, which says the United States "should assist in defending (Taiwan) against invasion, missile attack, or blockade by the People's Republic of China."

March 18, 1996
The PRC launches a joint force maneuver into the sea near Pingtan, Fujian Province.

March 19, 1996
The PRC stages a landing exercise on a small islet.

March 19, 1996
The Clinton Administration approves Taiwan's request to buy Stinger air defense missiles and other weapons, a move officials say reflects a longstanding US commitment to help Taiwan defend itself. In addition to the Stingers, weapons of last resort against close-in air attack, Taiwanese authorities have permission to buy an advanced targeting and navigation system for fighter jets and electronic warfare devices. However, Taiwan's request for submarines is turned down.

March 21, 1996

Taiwan's Defense Minister Chiang Chung-ling confirms reports that Taiwan will hold military exercises in its front-line Matsu Islands in early April, on the heels of China's war games in the Taiwan Strait.

March 22, 1996

USS Nimitz battle group arrives to the vicinity of Taiwan.

March 23, 1996

Taiwan holds its first-ever democratic elections for president as well as elections for members of the National Assembly.

March 26, 1996

China announced last night that its war games are over, temporarily halting moves to intimidate Taiwan, which completed an historic presidential election at the weekend. The United States announces that it will withdraw the US aircraft carriers currently operating in the area..

April 2, 1996

Taiwan postpones military exercises set for April 7-10 near China. Taiwan's Defense Ministry, responding to US and domestic concerns, says the war games will be rescheduled for a June 30 start "to avoid any misunderstanding and to ease tensions" in the region.

III.3 Impact on Oil Markets

Figures 3-6 below depict the impact of crisis events on the NYMEX oil market (figures for related markets are presented in Appendix A). Figures 3 and 4 summarize the major movements in the NYMEX spot price during this period. Of particular note is the gradual upward trend during most of this period culminating in several sharp jumps -- March 18, 19, and March 20, followed by a sharp drop on the 21st. Toward the end of March, the upward trend upward resumed peaking in mid- April.

The April price increases do not appear to be related to the Taiwan Strait crisis or its aftermath. According to accounts at the time appearing in the Financial Times, low stock levels and high demand because of cold weather hit the oil markets. Crude oil prices hit a five-year high in early April 1996, but later in the month began to drift down as consumption leveled off in the warmer season.

Figure 5, tracing the difference between the spot and first forward rate and the difference between the first and second forward rates in the NYMEX market, depicts how the markets perceived risk during this period. The spot is the daily NYMEX crude oil rate, while the forward markets refer to contracts for crude oil twenty or so months into the future. A standard measure of risk as perceived by the markets is the premium of the spot price over the price of the first forward contract, or first over second forward. In particular the premium for earlier over later delivery was apparent with the sharp increase in the speeds between the spot and first forward rate, especially on March 20. The spread between the first and second forward started widening dramatically March 14, reaching a maximum on March 19. Both measures fall dramatically after the arrival of the Nimitz battle group.

17

The downward sloping forward profiles (Figure 6) in the NYMEX market suggest that throughout March 1996 there was widespread concern over the availability of secure oil deliveries. Traders during this period were willing to pay a considerable premium for earlier rather than later delivery. The forward profiles peak at the height of the Taiwan crisis on March 19 and 20. After the arrival of the Nimitz battle group on March 22, however the profiles begin to drop.

Figure 3

NYMEX Spot Price

Figure 4

Daily Change in the NYMEX Spot Rate
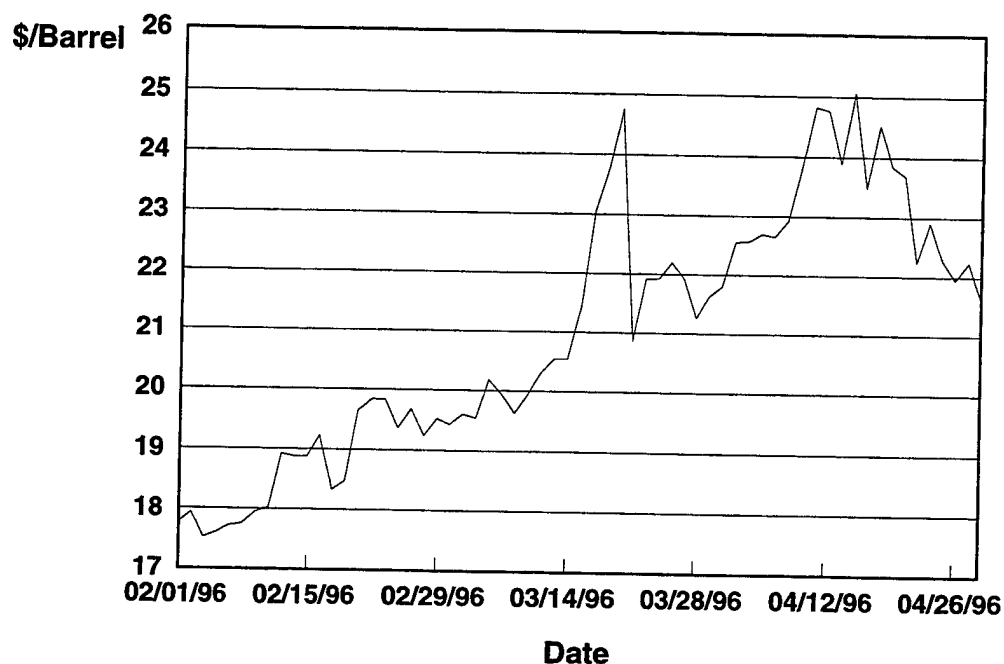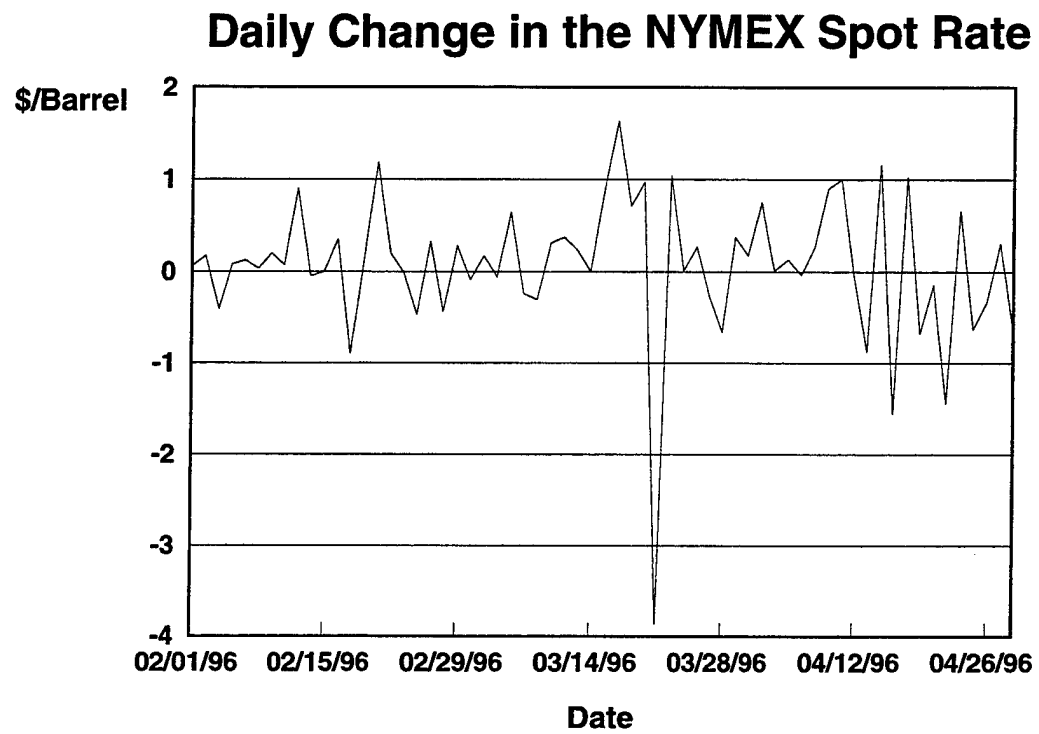
Figure 5

Taiwan Crisis:
NYMEX Spot/Forward Differentials

Legend
— Spot-First Forward
— First-Second Forword

Figure 6

NYMEX Forward Market Profiles
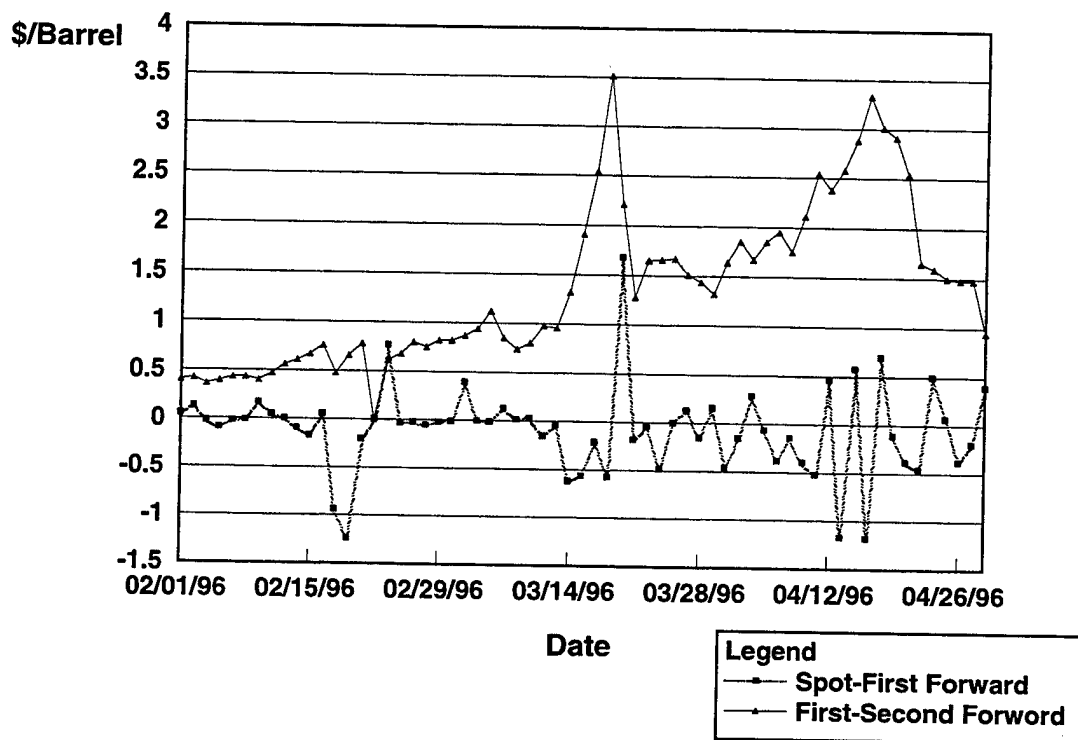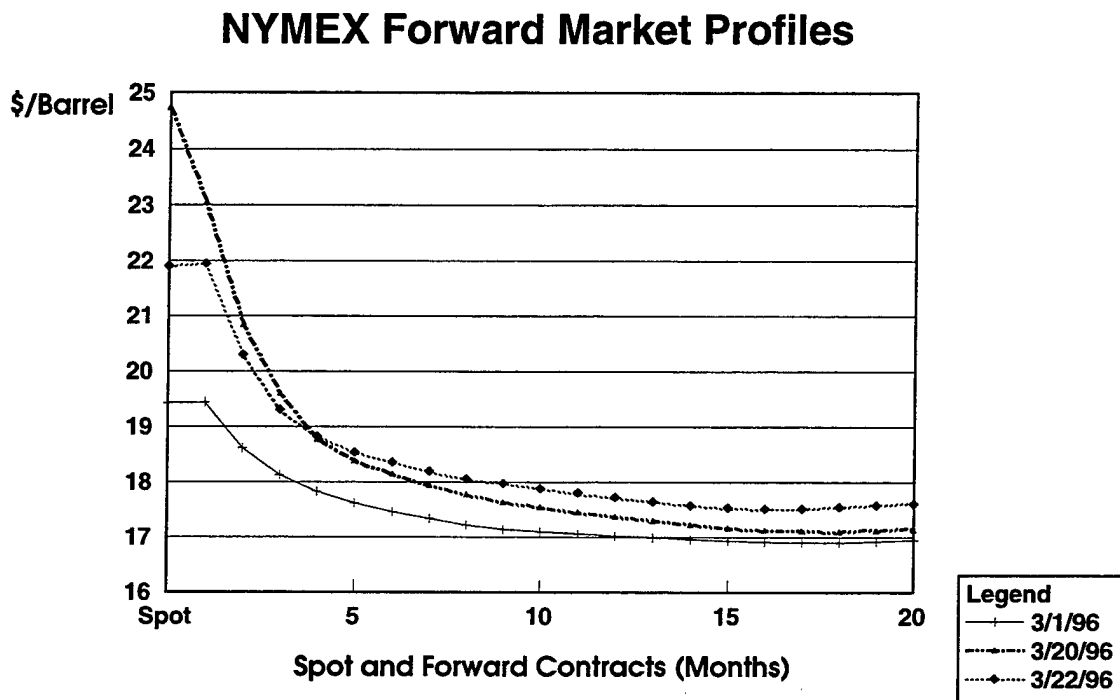
III.4 Event Analysis

The Taiwan Strait case offers a good opportunity to apply the event analysis discussed in the methodology section to the actions associated with the crisis timeline. If in fact the markets are concerned with an impending conflict that may be potentially disruptive to trade, there should be movement in price(s) in response to events that are perceived to either heighten or lessen the likelihood of shortages, delays and the like.

As noted in the methodology section, the key element in constructing an event analysis is the assignment of values for each key occurrence or development. Starting with the timeline, the following values were assigned on the basis of their perceived affect on oil markets. High values such +3 suggest that the markets interpret the event as one having potentially severe repercussions for continued production and availability of oil. On the other hand, a score of –3 suggests that market interpret this event as one likely to improve the environment for increased production and availability. As noted above, the key issue in the Taiwan Strait case is the manner in which the markets interpreted the movement of US naval forces.

The scoring in EVENT3 assumes a favorable response to naval action. A value of –2 is assigned to the December 19 action when the USS Nimitz battle group transited the Taiwan

21

Straits for the first time since 1979. A value of –3 is assigned to the March 22, 1996 action when the USS Nimitz battle group again arrived in the vicinity of Taiwan. The –2 and –3 scores are subjective and are assigned after a careful reading of the accounts of the time that suggest the March date provided a more decisive statement of US resolve. As a practical matter, the main findings of the case would not change if both events were scored with a –2 or a –3.

To test alternative interpretations of the manner in which key markets interpreted the significance of naval actions during this period, several other event scoring schemes were devised. In the first, EVENT3A, the December 19 event receives a +2 with the March 22 event maintaining its –3 value. In EVENT3B both naval events receive positive values and in EVENT3C all events, naval and non naval, receive a positive score. In short we have different interpretations of the manner in which markets may have assessed naval actions. These move from EVENT3 where the markets are relieved at US intervention to EVENT3B where the markets are concerned that US naval actions may lead to conflict and possible supply interruptions. EVENT3C assumes EVENT3B effects and, in addition, that all other non-naval events also destabilize the situation.

Summing up, based on this scheme, we would expect that if naval forces do in fact diffuse tension and restore market stability EVENT3 would have the strongest statistical associations with oil prices, this association would lessen with EVENT3A and be non-existent with EVENT3B and EVENT3C. The complete set of events and scores appear in Appendix B. The actual statistical output from the event analysis for this and other cases can be obtained from the authors upon request. The same applies to the national income models used to compute the economic impacts of crisis response by forward deployed naval forces.

The following sections apply the methodology outlined above. One advantage of this approach is that the same basic technique can be applied across a spectrum of different markets. After the oil markets, NYMEX, the analysis focuses on several of the regional share markets, the Hang Seng (Hong Kong) and the Nikkei (Tokyo). Following the logic outlined above for the oil markets, if naval events allay fears and concerns of escalating conflict we should expect these markets to increase in value following crisis response. Finally, event analysis is applied to the yen/dollar exchange rate. Again, we would anticipate an appreciation of the dollar if markets view naval crisis response as preventing the escalation of a regional conflict.

III.4.1 NYMEX Crude Oil Market

The first statistical examination of the impact of events on the NYMEX market involved assessing the determinants of the spread between the first and second forward contract. This spread is a standard measure of the market's assessment of risk. The greater the premium for immediate delivery, the greater fear traders have that the crisis will result in supply interruptions and delays—they are willing to pay a premium for immediate delivery rather than taking their chances on delivery at a later time.

Correcting for serial correlation and introducing the event variables produced a striking result. For all cases (separately using EVENT3, EVENT3A, etc.), increased daily volatility (as proxied by the difference between the close and opening of the day), presumably reflecting uncertainty, increases the spread between the first and second forward contract. When all of the event variables have a positive sign (EVENT3C) the event variable does not affect this spread (the variable is not statistically significant). However, as more and more individual events take on negative signs the statistical significance of the event term increases, culminating in EVENT3

where all US Navy developments have a negative sign. Here the event term reduces the premium on earlier delivery, suggesting that naval crisis response reassures the markets that supplies will not be disrupted.

Next, an analysis was undertaken of the short and longer-run impact of naval actions on oil prices (Figure 7). (The statistical results from the ARDL/error correction analysis that form the basis of the discussion below are available from Dr. Looney.) Here a similar pattern occurred. Starting with EVENT3C (all events cause oil price increases), there was no statistical relationship between the major crisis developments and oil price increases. However as the naval events were assigned negative signs (i.e., depicting the hypothesis that naval action reduces oil prices), the event term became both stronger in terms of the size of its coefficient and in statistical significance. Thus naval actions during this period contributed to lower oil prices than would have prevailed if naval activity had been absent.

The analysis also confirms that naval actions contribute to the long-term adjustment of the oil markets following various event shocks. As noted in the example in the methodology section, the error correction mechanism, or ecm term, controls this adjustment over time. The term itself reflects the NYMEX's deviation from the long-run historical pattern it has established with the Brent markets. The ecm term has a negative sign in the NYMEX price equation and is proportional to the difference between the NYMEX and Brent prices. For example, higher Brent prices would, everything else equal, reduce the size of the ecm term, thus reducing that term's negative impact on oil prices over time. EVENT3 is also in the ecm term suggesting that stabilizing naval actions control the movement of the NYMEX market price over time.

The negative sign on the EVENT3 term in the ARDL's ecm term is consistent with this interpretation. More negatively signed naval events, again everything else equal, would reduce the value of the EVENT3 term, thus increasing the size of the ecm term. Given the ecm term's negative impact on oil prices, the consequences of naval activity would be a slowing down over time in NYMEX price increases following other shocks.

It follows that increases in non-naval events (for the most part positively signed) would tend, as with increases in the Brent prices, to reduce the size of the ecm term, thus reducing price retarding pressures on the NYMEX markets. Finally these interpretations are consistent with the finding of a lack of statistical significance of event terms scored on the hypothesis that naval activity results in higher oil prices.

III.4.2 The Hang Seng Share Markets

Several observers have noted the apparent linkage between some of the Taiwan crisis events and simultaneous movements in the Hang Seng (Hong Kong) share index. However, just because that index goes up or down on one day or another would hardly seem to be of major significance for the United States economy, or any other major economy for that matter. On the other hand, if events such as naval actions affect the longer run adjustment of that market, there would no doubt be a number of important consequences for other markets and perhaps even major economies.

Following the methods used above to assess the movements in the NYMEX oil markets, the event terms were introduced to determine any possible short- and long-run associations with the Hang Seng Index. Here EVENT3, EVENT3A and so on retained their signs from the NYMEX analysis on the assumption that favorable events in the NYMEX markets (in the sense of lower oil prices) would have a predictable corresponding impact on the Hang Sing share

23

market (higher values). If we assume the same trader physiology across a wide variety of markets, naval events that lowered the price of oil should simultaneously raise share prices. It follows that the event variables should have the reverse signs in the Hang Seng equations from those found in the NYMEX market analysis.

Figure 7

Taiwan Strait Crisis:
Event Analysis of Developments and their Impact on the NYMEX Oil Markets

| Column 1 Statistically Insignificant | Column 2 Statistically Significant Short-Run Events | Column 3 Variables Maintaining Long Run Pattern with NYMEX Crude Oil | Column 4 Long-Run Adjustment | Column 5 Outcome |
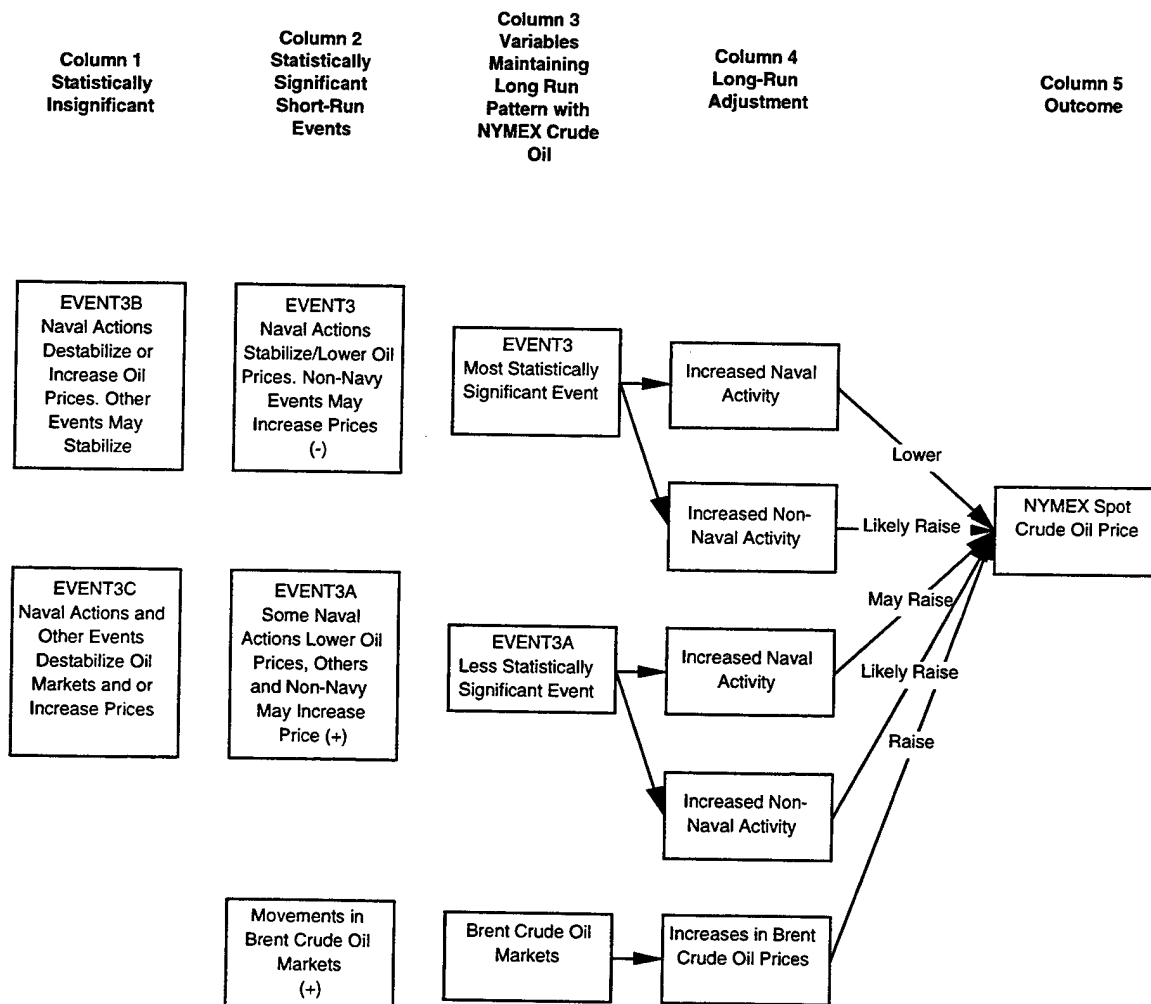
Note: Column 1 depicts the event measures (EVENT3B and EVENT3C) that were not statistically significant in affecting the NYMEX oil markets. The second column identifies those event variables (EVENT3 and EVENT3A) that formed a statistically significant relationship with the NYMEX markets. Drawing on Column 2, Column 3 depicts the variables (EVENT3, EVENT3A and the Brent markets that establish a long-run relationship with the NYMEX. Based on the signs of the regression coefficients, Column 4 summarizes the probable net impact (short- and longer-run effects) of naval and non-naval events on the NYMEX.

24

The main findings (Figure 8) show a pattern similar to the NYMEX analysis. Events EVENT3B and EVENT3C that incorporated positive signs for naval actions were not statistically significant. In other words the assumption that naval events accelerate uncertainty and instability lacks empirical verification. On the other hand the two events that assume a stabilizing role for naval actions (EVENT3 and EVENT3A) were statistically significant, with the significance increasing with all naval events possessing a negative sign (EVENT3).

In the short-run EVENT3 (naval events stabilizing) has a negative sign in the Hang Seng index equation. Clearly increased naval activities lowering the size of this term would tend to impact favorably on that market's overall valuation. The Hang Seng also moves in response to movements in the FTSE-100 and the New York Stock Exchange's Composite index.

In the longer term the ecm or adjustment term has, as in the NYMEX market, a negative sign. This suggests restraints on the longer run movements in the Hang Seng. For example, everything else equal, increases in the NYSE or the FTSE-100 tend to retard declines in the Hang Seng. In contrast to the NYMEX, the EVENT3 term has a negative sign in the ecm term. This suggests that positively signed (non-naval) events associated with the crisis increase the size of the ecm term, thus placing greater pressure on the Hang Seng to move downward over time. On the other hand the negatively signed naval events reduce the size of the ecm term, thus everything else equal, causing generally higher share prices over time.

III.4.3 The Nikkei Share Markets

The other major regional share market is the Nikkei (Tokyo). While this market was somewhat more removed from the conflict site, the Japanese economy itself is very dependent on access to energy and other critical imports. It is likely therefore that concerns over Taiwan would get translated into the Nikkei markets.

In most respects, the ARDL analysis of the Nikkei produced results (Figure 9) very similar to those obtained from the Hang Seng:

- The event variables incorporating the navy's stabilizing role are statistically significant. In contrast, those formulations based on the assumption that naval events produce increased uncertainty and instability were not statistically significant.

- The significance of the event variables increase as the navy's assumed stabilizing role increases.

- Naval activities produce not only a stabilizing short-run effect, but more importantly contribute to long-run movements in the Nikkei index. That is, naval events would be expected to increase the over-all value of the Nikkei over time.

- Conversely, non-naval crisis related events would most likely reduce share values over time.

- One difference between the Hang Seng and Nikkei indexes is the role of other share markets. The Hang Seng reflects movements in both the FTSE and the New York Stock Exchange Composite index.

- The Nikkei on the other hand does not appear (at least in the period under construction) to be affected by movements in these markets. Instead the Nikkei appears mainly influenced by movements in the dollar/yen exchange rate, with devaluations in the dollar/yen rate depressing share values.

Figure 8

Taiwan Strait Crisis:
Event Analysis of Developments and their Impact on the Hang Seng (Hong Kong) Share Market
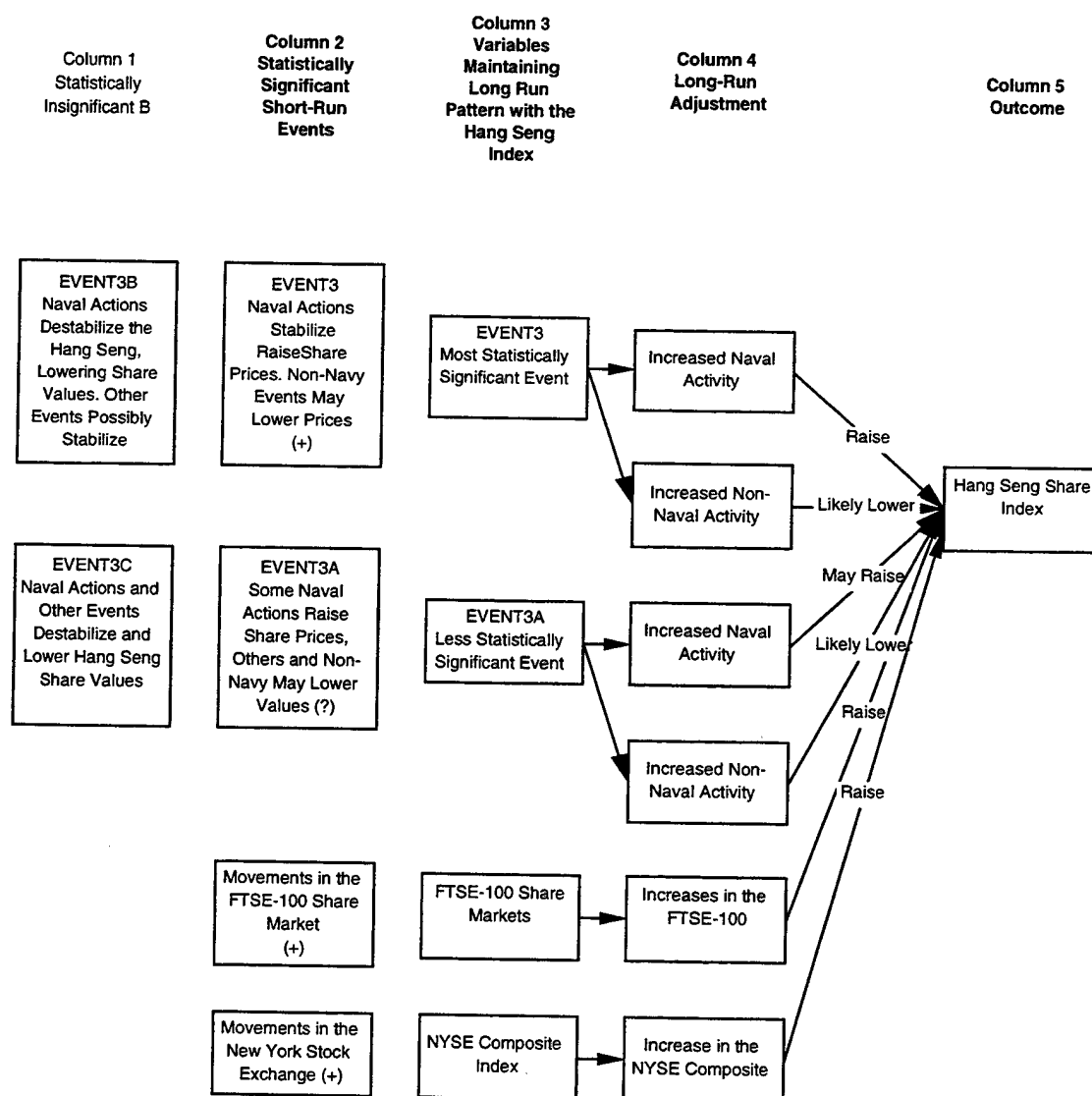
Note: Based on results from the ARDL/error correction analysis. See Figure 7 for a description of the main linkages and their interpretation.

Figure 9

Taiwan Strait Crisis:
Event Analysis of Developments and their Impact on the NIKKEI-225 (Tokyo) Index
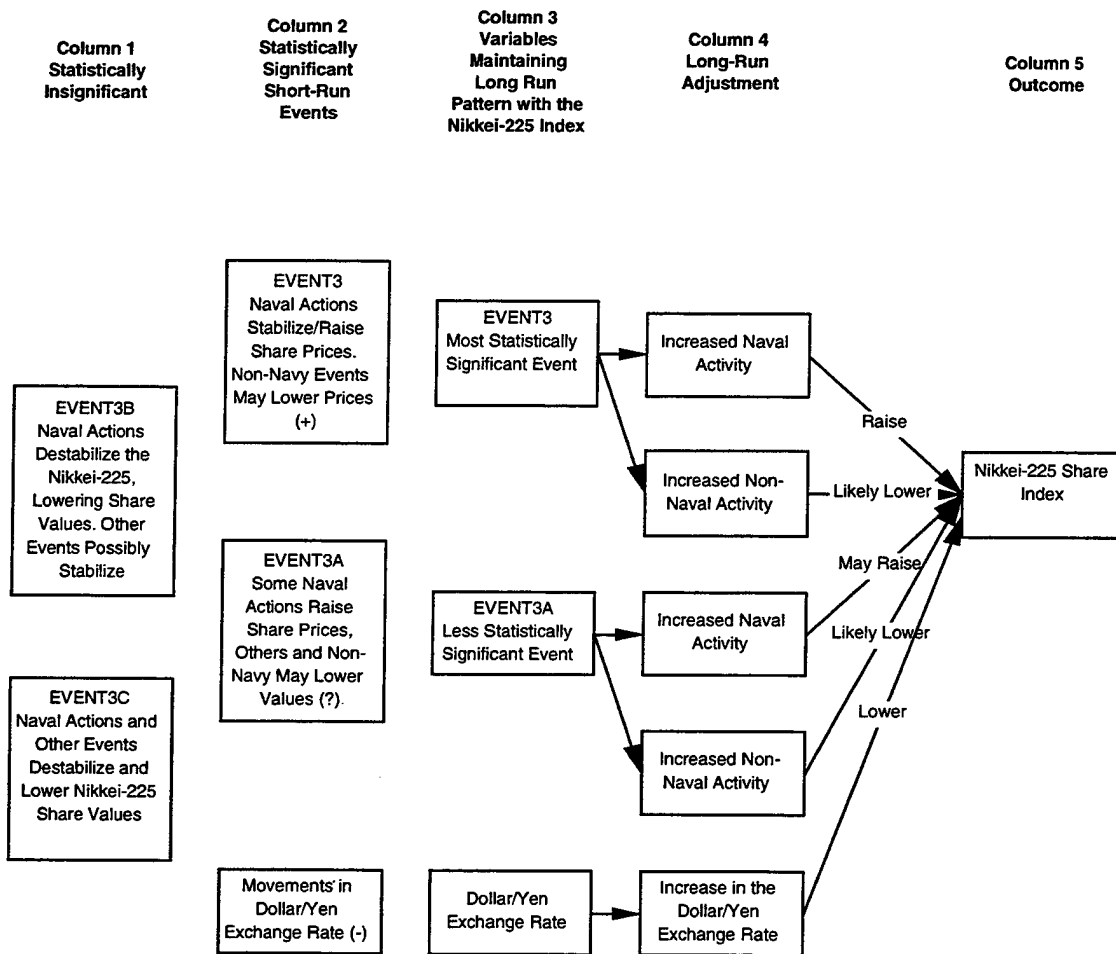
Note: Based on results from the ARDL/error correction analysis. See Figure 7 for a description of the main linkages and their interpretation.

III.4.4 The Dollar/Yen Exchange Rate

The dollar/yen exchange rate is of critical importance for both the United States and Japanese economies. If this exchange rate gets too far out of alignment, both countries can feel increased economic strains leading to frictions and conflicts in other areas. While it is controversial as to what the "correct" exchange rate between these two leading currencies is at any particular point in time, it is of interest to assess the manner that crisis affect that rate over time. Do confrontations such as the one in the Taiwan Strait strengthen or weaken the dollar with regard to the yen? Do naval events have a longer run carry over effect on the value at which these currencies trade? Again, the ARDL analysis identified (Figure 10) a series of key linkages between naval activity and the strength of the dollar.

The main findings of the dollar/yen event analysis are as follows:

- In contrast to the other markets examined, only the event variable (EVENT3) with all naval events having a negative signs was statistically significant.

- The short-run sign on EVENT3 is negative suggesting that increased naval activity (because of its negative sign) tends to cause an appreciation of the dollar (relative to the yen).

- Similarly, non-naval events because of their less predictable consequences tend to weaken the dollar.

- As noted above, the Nikkei is linked to the dollar/yen rate with increased value in the Nikkei causing a decline in the dollar (no doubt though investors shifting out of dollar assets to purchase an increased number of yen denominated shares).

- As with the other markets examined here, the event term contributes to the long-term adjustment in exchange rate markets. Given its negative value, the ecm term in the yen dollar equation tends to retard the appreciation of the dollar. For example the Nikkei has a positive sign in the ecm equation. Increased value in the Nikkei thus increases the ecm term, placing a drag on potential dollar appreciation.

- Similarly, the EVENT3 term has a positive sign in the ecm equation. Here, positively signed non-naval events would create increased uncertainty over conditions in the region. In turn this would be reflected in a larger ecm term and, given that term's negative sign in the dollar/yen equation, a suppressing effect on any potential dollar appreciation.

- Conversely, negative signed naval events would tend to reduce the size of the ecm term, thus providing, everything else equal, greater dollar appreciation over time.

Figure 10

Taiwan Strait Crisis:
Event Analysis of Developments and their Impact on the Dollar/Yen Exchange Rate

Column 1 Statistically Insignificant	Column 2 Statistically Significant Short-Run Events	Column 3 Variables Maintaining Long Run Pattern with the Dollar/Yen Exchange Rate	Column 4 Long-Run Adjustment	Column 5 Outcome

EVENT3A
Some Naval Actions Strengthen the Dollar/Yen Exchange Rate. Others and Non-Navy May Lower Rate

EVENT3
Naval Actions Stabilize/Raise The Dollar/Yen Rate. Non-Navy Events May Lower Rate (+)

EVENT3
Only Statistically Significant Event

Increased Naval Activity

Raise

Increased Non-Naval Activity —Likely Lower→

Dollar/Yen Exchange Rate

Lower

EVENT3B
Naval Actions Destabilize Dollar/Yen Exchange Rate lowering its Value. Other Events Possibly Strengthen the Exchange Rate

Movements in the Nikkei-225 Exchange (-)

Movements in the Nikkei-225 Exchange

Increase in the Nikkei-225 Exchange

EVENT3C
Naval Actions and Other Events Destabilize and Weaken the Dollar/Yen Exchange RateNikkei-225 Share Values

Note: Based on results from the ARDL/error correction analysis. See Figure 7 for a description of the main linkages and their interpretation.

29

III.4.5 Summary

Several results are of note. The four dominant markets in the region, NYMEX, the Hang Seng share market, the yen, and the Nikkei share market were all affected by the crisis with naval forward presence providing the impact one would expect if in fact the naval forces provided a stabilizing role—lower oil prices, higher share prices, dollar and the like.

Other markets, the Brent oil market, the CRB commodity markets, the Mark, the FTSE, the NYSE, the Dollar Index were not directly affected (at least not in the statistical sense used here). This suggests that the findings for the East Asian markets were not the result of a spurious correlation with some unspecified worldwide phenomenon.

On the other hand, since several of these markets were cointegrated with the East-Asian markets, it is likely there was a carry-over effect to other parts of the globe. Specifically, the Brent markets for example are highly cointegrated with the NYMEX. It follows that adjustments in the NYMEX subsequent to an event would ultimately alter the Brent Crude price of oil.

Most importantly the event analysis confirms the assumptions made below in the calculation of economic benefits associated with naval crisis response. The dates chosen were correct and the assumptions concerning the appropriate lags were also confirmed by the event analysis.

III.5 Economic Benefits

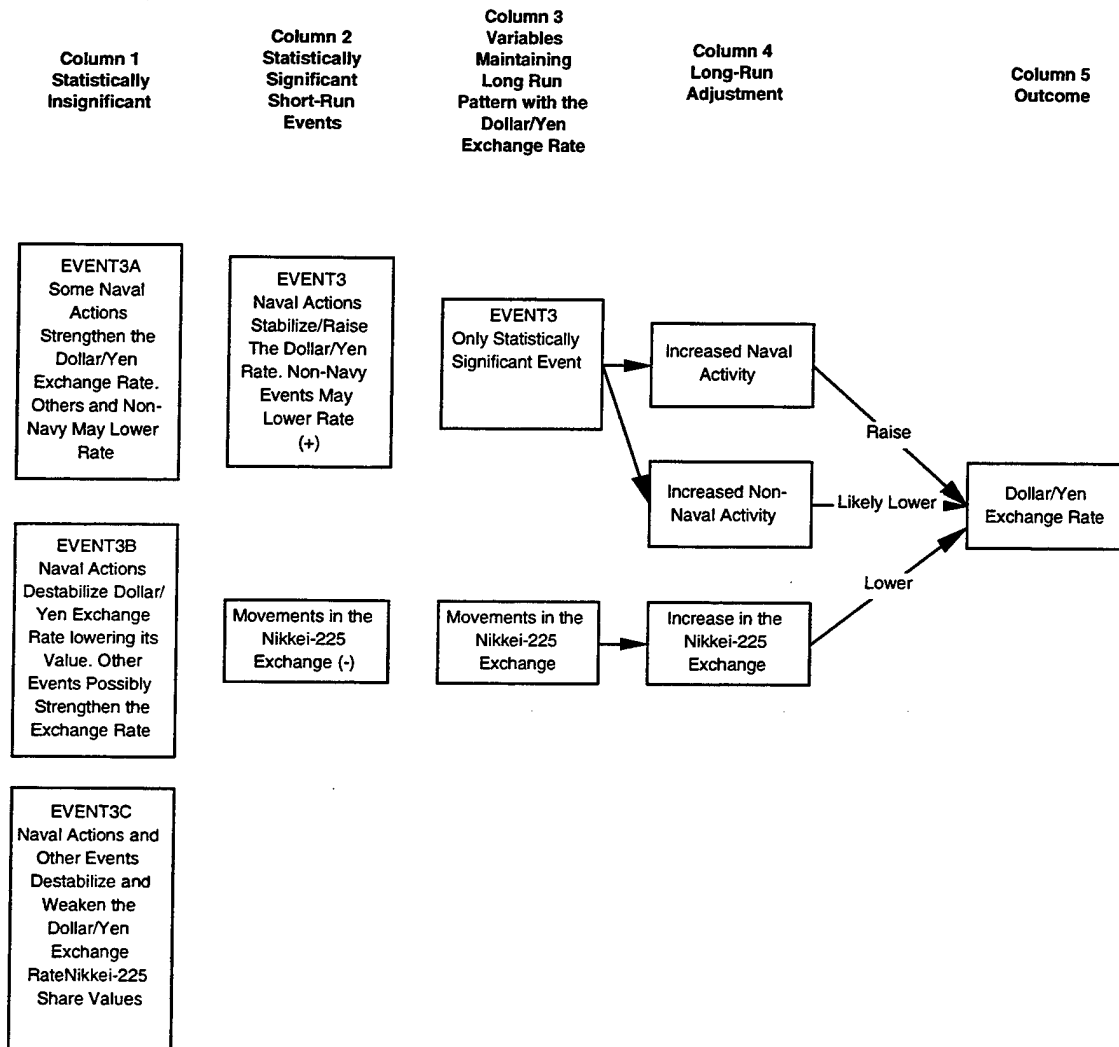The event analysis suggests that two key naval events occurring on December 19, 1995, and March 22, 1996 tended to reduce pressure on the NYMEX oil markets. The key dates for the calculations of economic benefits associated with naval forward presence/crisis response are:

March 1, 1996
A benchmark before the crisis unfolds. This was a period of relative stability in the oil markets before a series of announcements and press speculations set off increases in the price of oil.

March 20, 1996
Based on the movements of the spot and forward profiles, this date appears to be the peak of the crisis, or at least the period of greatest uncertainty precipitated by a series of hostile PRC statements and actions

March 22, 1996
USS Nimitz Battle Groups arrive in the vicinity of Taiwan, which as the event analysis suggests was a key element in stabilizing the oil/share and exchange rate market.

The NYMEX forward profiles (Figure 6, page 21) depict development in the oil markets on these key dates.

III.5.1 Assumptions

As the event analysis suggests, naval actions during this period had a number of significant impacts on key markets: the NYMEX crude oil market, the Hang Seng and Nikkei share markets and the Dollar/Yen exchange rate. Translating these impacts into tangible economic benefits to the United States economy, however, is complicated by several conceptual problems.

30

First, the great time difference between Taiwan and New York makes the selection of dates for the calculation a bit fuzzy. Although the Nimitz arrived in the vicinity of Taiwan on March 22 (local time), this was still March 21 in New York, and hence some of the effect of this naval action was no doubt registered in the NYMEX on the 21st. On the other hand the event analysis suggests that the optimal lag for the naval event impact was one day, which suggests that March 22 is probably the more reliable date for the calculation of benefits.

Second, just what crisis and run up in oil prices did the Nimitz affect? Should the differential between March 1 and March 22 be the interval for the Nimitz's impact? This calculation would suggest that the Nimitz effect's benefits be calculated in terms of some earlier equilibration in the oil markets before the initiation of Chinese actions and announcements. Unfortunately setting a date, say, before March 5 (key Chinese announcement) is somewhat arbitrary. As noted, March 1 makes sense, but there are other candidates as well. Alternatively, is it the difference between the height of the crisis on March 20 and March 22? The latter would seem to provide a more tangible situation to examine.

III.5.2 Findings

Following the methodology outlined earlier in the report, the economic impact on the US economy is calculated on the basis of the different prices that were reflected by the forward markets on the key dates noted above. In turn, these prices shock key variables in the US economy—mainly several types of investment. Shifts in investment as well as energy and exchange rates in turn ripple through the economy to change Gross Domestic Product from what it would be under a different set of oil/exchange rates. In short, what would the US economy have looked like if the prices existing in forward markets on March 20 and March 22 actually come to pass? The differences in GDP under each scenario represent the economic impact associated with naval forward presence/crisis response.

As a basis of comparison, three calculations derived from the assumed future NYMEX oil price and the dollar/yen exchange rates as they impact on the VAR model of the US economy are presented (Table 2):

- A total crisis impact—based on the different economic environments associated with (March 1 – March 20 interval)

- Crisis Response A – reflecting date/time vagueness -- based on the different economic environments associated with (March 20-March 21 interval)

- Crisis Response B – the best estimate for reasons noted above – based on the different economic environments associated with (March 20-March 22 interval).

Summing up:

- The most likely sum of economic benefits derived by the United States from Naval Forward Presence during this period is approximately $3.4 billion (1995) dollars (Crisis Response B).

- A slightly less plausible estimate is $6.4 billion (Crisis Response A).

31

- However, if one argues that the true benefits associated with naval forward presence and crisis response should be measured in terms of a counterfactual decline in GDP that might have occurred if no naval response whatsoever was made, then a high, but still credible estimate, would lie between Crisis Response A and the Crisis Response Impact totaling 14.9 billion [6.4 - (-8.5)] and Crisis Response B and the Crisis Response Impact or 11.9 billion [3.4 - (-8.5)].

III.6 Conclusions

The findings for the Taiwan Strait Crisis came at somewhat of a surprise. Most analysts had assumed that because oil was not directly involved, the economic benefits associated with this naval crisis response were nill. While several markets including the Hang Seng were examined (System Planning Corporation 1996), the general feeling was that the movements in these regional markets were more overnight effects, perhaps more influenced by movements in US interest rates than crisis events. The conventional wisdom was that their movements were unlikely to be of much significance for the United States economy. For this reason, our initial study did not delve into the case.

In contrast, the analysis above shows that the crisis and associated naval events affected a wide variety of markets including the important NYMEX crude oil price. More importantly, the events of the crisis not only produced the overnight effects but also set off a long-run adjustment process with naval events providing a significant stabilizing role—lowering oil prices and increasing the values of shares and the dollar from ranges they would have assumed in the absence of naval intervention. These market movements and associated forward prices then impacted the United States Economy to produce significant savings in lost GDP of, at a minimum, 3.4 billion 1995 US Dollars.

Table 2

Taiwan Strait Crisis:
Naval Forward Presence Impact on the United States Economy
Oil Price/ Dollar-Yen Effects

(United States GDP in Billions 1995 Dollars)

	Crisis Response Impact	Crisis Response A	Crisis Response B
Quarterly Impact			
1996Q1	0.6	-0.3	-0.2
1996Q2	1.7	-0.6	-0.2
1996Q3	0.7	0.1	0.3
1996Q4	-0.5	0.7	0.6
1997Q1	-1.5	1.2	0.8
1997Q2	-2.4	1.6	0.9
1997Q3	-3.2	1.8	0.7
1997Q4	-3.9	1.9	0.5
Total Impact			
Through 1997	-8.5	6.4	3.4

Notes: The statistical output of the ARDL/error correction analyses and VAR models on which these results are based are contained in a separate set of appendices available from the authors.

Crisis Response Impact derived by subtracting the United States' GDP estimated on the assumption of March 1 oil and dollar/yen forward prices from that estimated on the basis of March 20 oil, dollar/yen prices.

Crisis Response A = same calculation as Crisis Impact but with (March 21 minus March 20) prices.

Crisis Response B = same calculation as Crisis impact but with (March 22 minus March 20) prices.

VAR Model Construction:
Dependent Variables: GDP (USARGDPS), Private Consumption (USACSMRX), Gross Fixed Capital Formation (USAINVTS), Expenditure on Machinery and Equipment (USAIMCHS), Construction (USAICONS), Government Consumption (USAGOVTX). Exogenous Variables: Oil Prices (NYMEX), Dollar Yen Exchange Rate (YEN) with March 1, 20, 22, 1996 Spot and Associated forward rates: 1996Q2 – 1997Q1. VAR Model Order = 1.

IV. Operation Desert Strike

IV.1 Overview

In early 1996, despite warnings from the United States, Iraq moved 40,000 troops into northern Iraq threatening the Kurdish population. In response, the president ordered a strike on military targets posing a threat to coalition aircraft in the no-fly zone.

On August 31, 1996, elements of the Iraqi Army attacked and captured the town of Irbil in the Kurdish autonomous region of northern Iraq. This renewed Iraqi aggression, led by a Republican Guard mechanized division with the support of regular army troops, alarmed the United States and coalition forces in the region. Rhetoric from Baghdad threatened Gulf Cooperation Council (GCC) partners if they assisted the United States in retaliation, while Iraqi air defense forces launched surface to air missiles against USAF fighter aircraft patrolling the northern and southern "no-fly" zones. In response to the seizure of Irbil, the US Central Command assessed an increased threat to America's interests and moved quickly to bolster its ability to protect those vital national interests on the Arabian Peninsula. In close consultation with the National Command Authority (NCA), Central Command began to develop appropriate military responses to deter further aggression.

Saddam's actions suggested a new willingness to use overwhelming conventional forces to continue their oppression of the Kurds. This willingness increased the threat of aggression against allied forces enforcing United Nations resolutions and international relief workers delivering humanitarian supplies.

To prevent enhancement of offensive capabilities in the south and prepare for potential follow-on operations, the NCA directed an immediate military response. In consultation with its coalition partners, Central Command evaluated alternative responses from among those available in the region. Against a requirement to send a clear signal of international condemnation for the latest violation of UN resolutions, Central Command planned and executed Operation Desert Strike.

IV.2 Timeline

As opposed to the other cases, there was not a long sequence of specific events leading up to Desert Strike. No doubt the US government conveyed warnings to Iraq through diplomatic channels. However, there were not the public warnings that alert markets that a crisis is impending. For this reason, it was impossible to carry out an Event analysis as in the other cases under review.

September 2, 1996

A coordinated cruise missile attack was launched against the Iraqi air defense infrastructure, including surface-to-air missile sites and command and control nodes in southern Iraq. USS Laboon (DDG 58) and USS Shiloh (CG 67), on station in the Gulf as part of Task Force 50, fired 14 of the 27 cruise missiles while Air Force B-52s, escorted by F-14s from USS Carl Vinson (CVN 70), fired 13 conventional air-launched cruise missiles (CALCMs).

34

<u>September 3, 1996</u>
A second strike of 17 Tomahawks from destroyers USS Russell (DDG 59), USS Hewitt (DD 966), USS Laboon and nuclear-powered attack submarine USS Jefferson City (SSN 759) was conducted. USS Enterprise (CVN 65) departed the Adriatic Sea on order of the National Command Authority and conducted a high-speed transit through the Suez Canal, arriving in the theater two days later.

IV.3 Oil Market Developments

Oil prices were increasing prior to the US missile launch on Iraq (Figure 11). As the New York Times noted ("Oil Prices Advance After UN Delays Iraq's Entry in the Market," September 3, 1996, p. D-6), much of this increase stemmed from the United Nation's delays in letting Iraq sell oil again. The dollar also rose, and the shares of oil companies rose on foreign exchanges, benefiting from renewed tension in the Middle East. At this time it was clear that traders had been expecting Iraq's first oil sales since the Persian Gulf War to hit markets in the next several weeks. Traders noted (Financial Times, The Lex Column: "Flying High," September 3, 1996, p. 1) that uncertainty over the timing of Iraqi crude exports, which had been expected later in September, should underpin oil prices at least in the short-term.

On September 3, the Financial Times (Robert Corzine, "Delay to Iraqi Sales Boosts Oil Prices," September 3, 1996, p. 5) also noted that any allied military action against Iraq could give a further boost to oil prices (which had been rising sharply over the past month due to unease about the tougher US position towards Iran and the wider potential for Middle East instability). At this time (September 3) concern over increased world oil prices and expectations of a rise in US interest rates led to a rise in the US dollar against the D-mark and the yen (Appendix C).

On September 5, The Financial Times (Robert Corzine, "Oil Price Yo-Yos as Traders Digest News From Iraq," September 5, 1996, p. 3) noted that international oil companies and traders continued to adjust their buying strategies to reflect the widespread expectation that Iraqi oil will not be a factor in world markets this year. Many traders had already shifted their attention to possible alternative sources. Much debate centered on whether countries outside the Organization of Petroleum Exporting countries could step in to make up for any shortfall.

IV.4 Key Events for Economic Benefit Calculations

<u>September 2, 1996</u>
A coordinated cruise missile attack was launched against the Iraqi air defense infrastructure.

<u>September 3, 1996</u>
A second strike of 17 Tomahawks from destroyers was launched.

<u>September 4, 1996</u>
The key developments on this date were the decline from September 3 in the NYMEX spot rate. Also on September 4 the spot rate had fallen below the first forward contract. The first forward contract was also smaller than the second forward contract. These patterns suggest that the markets quickly equilibrated once naval operations were concluded. Apparently, traders assumed that the US mission had been accomplished and there would be no Iraqi follow-ups that would jeopardize stability in the region.

September 16, 1996

By September 16, the second future contract (Figure 12) was trading at a sizable premium over the first forward contract. This pattern suggests that the markets had assessed the military situation in the Gulf and had concluded that stability was assured for the foreseeable future. The markets heavily discounted the possibility of increased Iraqi destabilization.

Figure 11

NYMEX Spot Oil Prices

Date
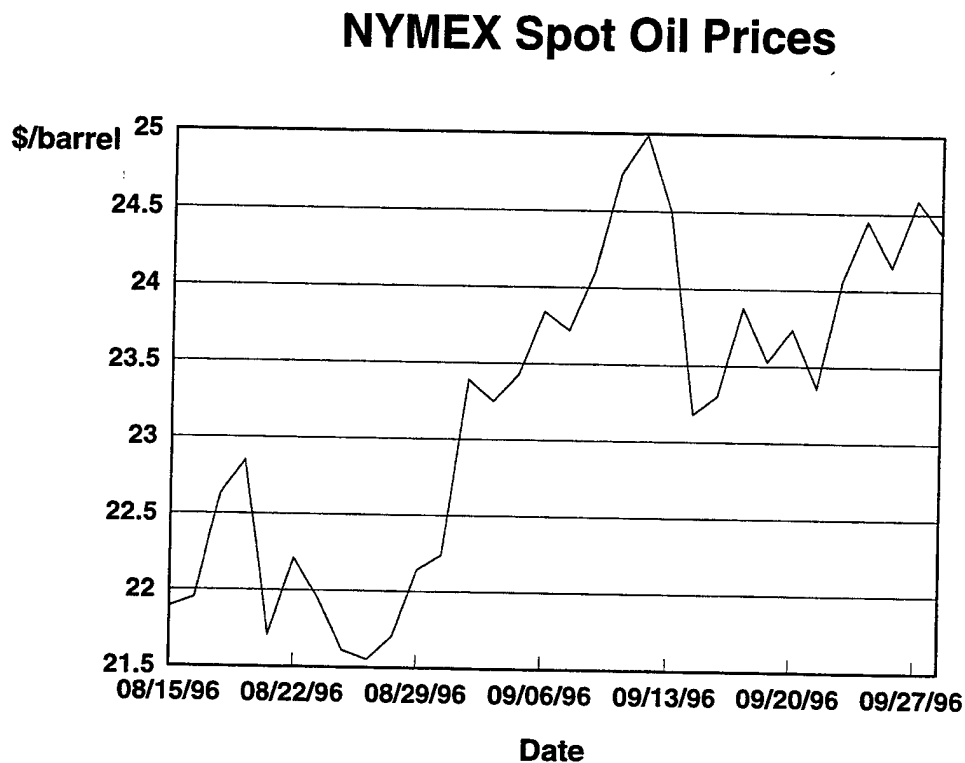
Figure 12

NYMEX Oil: Spot and Forward Patterns

Legend
········ Spot-First Forward Contract
——•—— First Future-Second Future Contract
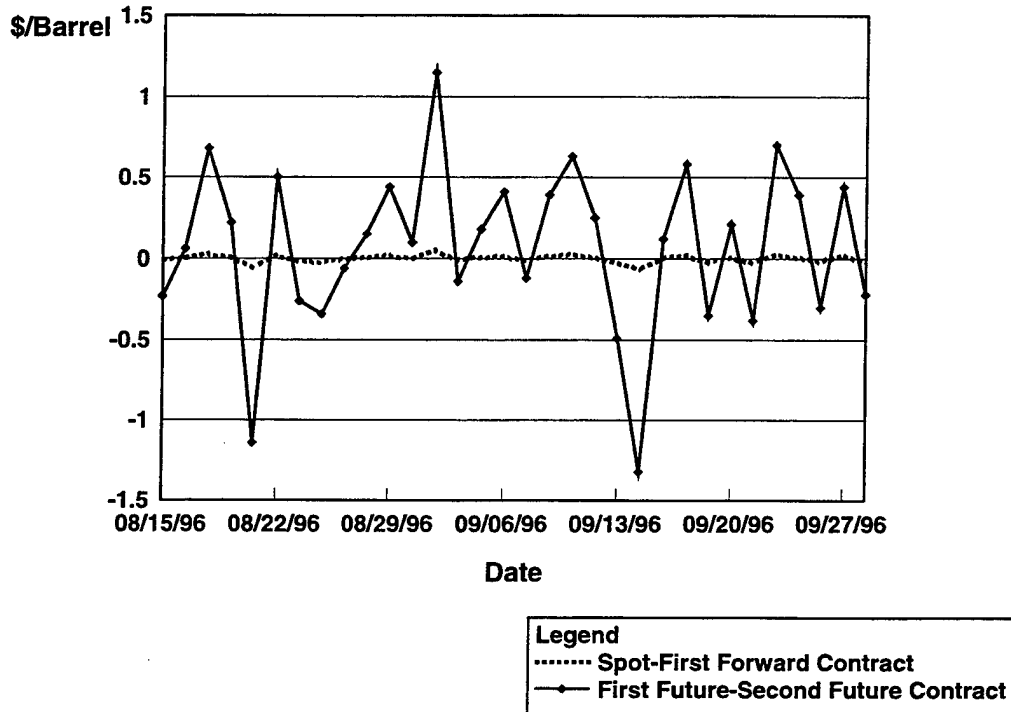
IV.5 Calculation of Economic Benefits

Initial tests of the VAR Model for the United States economy suggested that both the NYMEX spot oil price (NYMEXS) and the dollar/yen exchange rate (YEN) were statistically significant. The dollar index itself (DI) was not statistically significant and was hence omitted from the analysis. Based on the Schwartz Bayesian Criterion, the optimal VAR order was set at 1.

In addition to the NYMEX and YEN rates, the variables used in forecasting the US economy were: gross fixed capital formation (USAINVTS), Investment in Machinery and Equipment (USAIMCHS), and government final consumption (USAGOVTX).

IV.5.1 Assumptions

Using these variables and the forward rates associated with the dollar/yen and NYMEX oil prices for September 3, September 4 and September 16, estimates were made of the differential in US GDP that was implied by the start and conclusion of naval operations. The first calculation is the short-run equilibration following cessation of operations. That is, the United States GDP was estimated on the basis of the forward prices prevailing on September 4 and September 3.

37

The differential GDP (September 4 – September 3) projected by these two patterns of dollar/yen and NYMEX rates is the short-run impact of naval operations. Assuming the markets had fully equilibrated by September 16, as second set of calculations was made, again using the forward rates of the dollar/yen and NYMEX on that date. The September 3 forecasts of US GDP were then subtracted from these (September 16 – September 3), to arrive at the full impact of Naval operations.

IV.5.2 Findings

The model shows continued gains over time (Table 3). However it is unlikely that the true impact of naval operations lasted much past 1997. A safe estimate is that the benefits of naval forward presence were somewhere between 2.0 and 4.2 billion 1995 dollars.

IV.6 Conclusions

This is an interesting case in that it was of very short duration and came at a time when oil markets were on the upswing. There was also considerable uncertainty on the manner in which Iraq would respond to the operation. Despite these rather adverse conditions, Naval operations were able to play a significant role in stabilizing oil markets, thus producing again significant economic benefits to the United States economy.

Table 3

Operation Desert Strike:
Naval Crisis Response Impact
on the United States Economy: Oil Price/Yen Effects

(Billions 1995 Dollars)

	Initial Impact A	Impact Equilibrium B
Impact by Quarter		
1996Q3	0.0	0.2
1996Q4	0.0	0.2
1997Q1	0.1	0.2
1997Q2	0.1	0.3
1997Q3	0.2	0.5
1997Q4	0.3	0.6
1998Q1	0.3	0.6
1998Q2	0.3	0.6
1998Q3	0.3	0.5
1998Q4	0.3	0.5
1999Q1	0.3	0.5
1999Q2	0.4	0.5
1999Q3	0.4	0.5
1999Q4	0.4	0.5
Impact Through 1997	0.7	2
Impact Through 1998	1.9	4.2
Impact Through 1999	3.4	6.2

Notes: The statistical output of the ARDL/error correction analyses and VAR models on which these results are based are contained in a separate set of appendices available from the authors.

Initial Impact = (September 4 – September 3; Impact Equilibrium = (September 16 – September 3).

Initial Impact derived by subtracting the United States' GDP estimated on the assumption of September 3 oil and dollar/yen forward prices from that estimated on the basis of September 4 oil and dollar/yen prices.

Impact Equilibrium derived by subtracting the United States' GDP estimated on the assumption of September 3 oil and dollar/yen forward prices from that estimated on the basis of September 16 oil and dollar/yen prices.

V. Operation Desert Fox

V.1 Overview

The tensions over weapons inspections that began in October 1997 continued into 1998. In February, U.N. Secretary-General Kofi Annan worked out an agreement with Iraq that resumed weapons inspections. In turn, Iraq received promises the United Nations will consider removing its economic sanctions. Inspections continued into August, when Iraq cuts ties with weapons inspectors, claiming it has seen no U.N. move toward lifting sanctions. The objectives of Operations Desert Fox were to degrade Iraq's ability to produce and use weapons of mass destruction and to demonstrate the consequences of violating international obligations.

V.2 Timeline

October 31, 1998
    Iraq cuts off all work by U.N. monitors. The United States and Great Britain warn of possible military strikes to force compliance. A renewed military build-up in the Persian Gulf begins.

November 5, 1998
    The UN Security Council condemns Iraq for violating agreements signed after the end of the 1991 Persian Gulf War.

November 11, 1998
    With B-52 bombers in the air and within about 20 minutes of attack, Saddam Hussein agrees to allow U.N. monitors back in. The bombers are recalled before an attack occurs. Weapons inspectors return to Iraq a few days later.

December 8, 1998
    Chief U.N. weapons inspector Richard Butler reports that Iraq is still impeding inspections. UN teams begin departing Iraq.

December 16, 1998
    A formal UN report accuses Iraq of a repeated pattern of obstructing weapons inspections by not allowing access to records and inspections sites, and by moving equipment records and equipment from one to site another.

December 17, 1998
    The United States and Great Britain begin a massive air campaign principally involving our naval forces. The operation involved Navy and Marine Corps strike aircraft from the USS Enterprise and over 200 Tomahawk cruise missiles launched from Navy ships. The attack began at 0100 Thursday. In addition, the USS Carl Vinson, was ordered to speed up its movement from the Indian Ocean into the Persian Gulf. In the morning, 2,000 marines from the amphibious assault ship USS Belleau Wood conduct training exercises close to the Kuwait border. A second round of air strikes begins in the early evening, Iraqi time. The second wave sends cruise missiles

deep into Iraq and Navy strike aircraft with laser-guided bombs targeting Iraqi air defenses along the border.

December 18, 1998
    Third night of attacks.

December 19, 1998
    Explosions shake central Baghdad. A second US aircraft carrier battle group led by the USS Carl Vinson moves into the Gulf.

December 20, 1998
    President Clinton suspends military action against Iraq after a fourth day of air strikes saying the "operation is now complete."

V.3 Event Analysis

An event analysis of the period October 1 through December 31, 1998 was undertaken to determine if a valid statistical relationship existed between naval actions in the Gulf and the major oil, commodity, and share markets. As with the event analysis of the other cases, the main goal of this exercise is to determine whether and to what extent a statistical association exists between naval events and the movements of prices in these markets. If an association exists, is it a positive one of assuring the markets of stability and security, or, in contrast, is the relationship one of increased uncertainty over future oil production and access?

Using the time line for the main events during this period (October 1 through December 31, 1998), the key events are coded (Appendix D) to test these alternative views of naval forward presence and crisis response. In actuality, the two series differ on only two dates, December 17 and 18. EVENTA assumes the naval actions on these days created increased concern over oil availabilities from the Gulf and hence forced oil prices up (the events are assigned a positive number). In contrast EVENTB looks at these events as an indication of US resolve and commitment to preserving stability in the region. It follows that the events are assigned a negative sign in EVENTB.

Using these two sets of event codes as independent variables, a cointegration/error correction analysis was undertaken to determine the manner in which naval actions interacted with key economic markets. This analysis is ideal for the problem at hand because it focuses on the problem of identifying shocks to a system and the manner in which the system adjusts to those shocks. Specifically, the analysis breaks down patterns over time into two components, a short-run impact (event) and a longer run adjustment whereby historical patterns are re-established.

V.3.1 The NYMEX Crude Oil Market

Analysis of the NYMEX crude oil markets suggests that the naval actions during this period stabilized rather than destabilized oil markets. Specifically, EVENTB is statistically significant over a wide variety of alternative specifications, whereas EVENTA is statistically insignificant in all cases.

The analysis also validates the applicability of the cointegration/error-correction mechanism in this market. That is, the NYMEX market is characterized by being affected by a

series of short-run shocks (events). Following these shocks, a longer-run period of adjustment restores the NYMEX's historical relationship with other commodity/energy markets. The main findings are outlined in Figure 13.

Figure 13

Operation Desert Fox: Event Analysis of the NYMEX Crude Oil Market

Column 1 Statistically Insignificant	Column 2 Statistically Significant Short-Run Events	Column 3 Variables Maintaining Long Run Pattern with NYMEX Crude Oil	Column 4 Long-Run Adjustment	Column 5 Outcome

EVENTA
Naval Actions
Increase Oil
Prices

EVENTB
Naval Actions
Reduce Oil Price
Pressures
(-)

EVENTB
Non-Naval
Actions May
Raise Oil Prices
(+)

Brent Oil Markets
(+)

CRB Commodity
Futures Index
(+)

Movements in
Goldman Sachs
Commodity
Futures Markets
(+)

EVENTB
Naval/Non-Naval
Actions

Increased Naval
Activity

Increased Non-
Naval Activity

Lower

Likely Raise

Brent Oil Markets → Increases in Brent Oil Price

CRB Commodity Futures Index → Increases in CRB Commodity Futures Index

Goldman Sachs Commodity Futures Markets → Increases in Goldman Sachs Futures Prices

Raise
Raise
Raise

NYMEX Spot
Crude Oil Price

Note: Graphical depiction of the results from the ARDL/error correction analysis. In the short-run naval actions reduce oil price pressures, whereas non-naval actions increase prices in these markets. The same applies to movements in the Brent oil markets, the CRB commodity futures index and the Goldman Sachs Commodity Futures Markets. Naval/non-naval events along with these three markets also form a long-run pattern with the NYMEX with naval actions the only variable lowering oil prices over this time interval.

Given their negative sign in the EVENTB variable and that variable's positive sign in the NYMEX regression equation, it is apparent that naval actions lower the spot oil price. In contrast, other events such as Iraqi belligerence, etc., would tend to raise the price of oil. Since the

42

NYMEX establishes a long–run pattern with several commodity markets, the CRB and the Goldman-Sachs, increases in their price is also reflected in movements in the NYMEX.

Because the NYMEX maintains a long-run pattern with other commodity markets, naval events also play a role in re-establishing these relationships through influencing the pattern of long-run adjustment. An error correction process through which oil market equilibrium is restored depicts this adjustment mechanism. In the case at hand, a typical pattern is one whereby the error correction term (ecm) has a negative sign in the NYMEX equation. This means that increases in the ecm reduce price pressures in the NYMEX market.

A typical pattern in the ecm equation is one in which a variable such as the Brent oil price has a negative sign. Increases in the Brent oil price therefore set off a process of adjustment in the NYMEX market to restore the long-run pattern between the two markets. Because the BRENT variable has a negative sign it reduces the size of the ecm term. This in turn, because of it's negative sign in the NYMEX equation, results in upward pressure on the NYMEX, thus aiding in reestablishing the long-run patterns between the two markets.

The EVENTB variable also has a negative sign, suggesting that as with the BRENT, increased values would tend over time to result in increased NYMEX oil prices. This is clearly true for the non-naval events. However, since naval events have a negative sign in this variable, the reverse occurs. That is, everything else equal, naval events during this period actually resulted in lower prices over time as a mechanism of restoring equilibrium in the NYMEX market.

V.3.2 The S&P-100 Index

Share prices are quite volatile and are said to reflect the market's assessment of key events' impact on future profitability and the like. In general the markets prefer certainty and, more often than not, increase in value during periods of relative stability. As is well known, the share markets are averse to uncertainty, often going into prolonged declines until whatever they are leery of is resolved. One often hears that US naval actions, particularly ones similar to those examined in this case, create, in the net, more doubts and uncertainty over future economic conditions and hence depress the share markets. In actuality, the event analysis suggests that quite the reverse is the case.

Event analysis again identified the existence of a number of long-run patterns that are re-established following a destabilizing event. In the case of the S&P-100, long-run patterns at this time existed with the New York Stock Exchange Composite index (NYSE) and the dollar index. See Figure 14. Increases in the NYSE and the dollar index set off a long-run-adjustment in the S&P raising its value commensurate with the other two. EVENTB has a negative relationship (negative sign in the S&P value equation). Everything else equal, an increased level of events should depress the S&P. This is true for most events. However, naval events in EVENTB have a negative sign so their presence actually results in an increase in share prices.

EVENTB has a positive sign in the ecm or long-run correction effect following a shock. Given the negative sign of the ecm in the S&P share price equation, it appears that most events would again tend to reduce the value in this market. Again however, because naval events have a negative sign in the EVENTB term, their presence actually results in increased share prices during the long-run adjustment process.

43

V.3.3 The CRB and Goldman Sachs Commodity Indexes

These two key commodity indexes were also affected by developments during this period in the Gulf. See Figures 15 and 16. The mechanisms are quite similar to those associated with the NYMEX market described above. Both markets reacted negatively (increased price due to perceived risk) to non-naval events in the Gulf. As with the NYMEX, both markets interpreted naval events as providing increased security and certainty of supplies. This was true not only in terms of the short-run impact of naval events, but through their affecting lower prices over time during the period of longer-run recovery from events in the region.

V.3.4 Implications

The important finding here is that while naval events have an apparent short-run stabilizing effect on key markets, they also set off a long-run adjustment process (at least in the markets examined here) that is subtle, but more significant in terms of total magnitude. In large part, the subtle nature of these long-run effects explains why they have not been previously detected and have thus received little or no attention in the debates over the economic consequences of naval forward presence.

Figure 14

Operation Desert Fox: Event Analysis of the S&P-100 Index
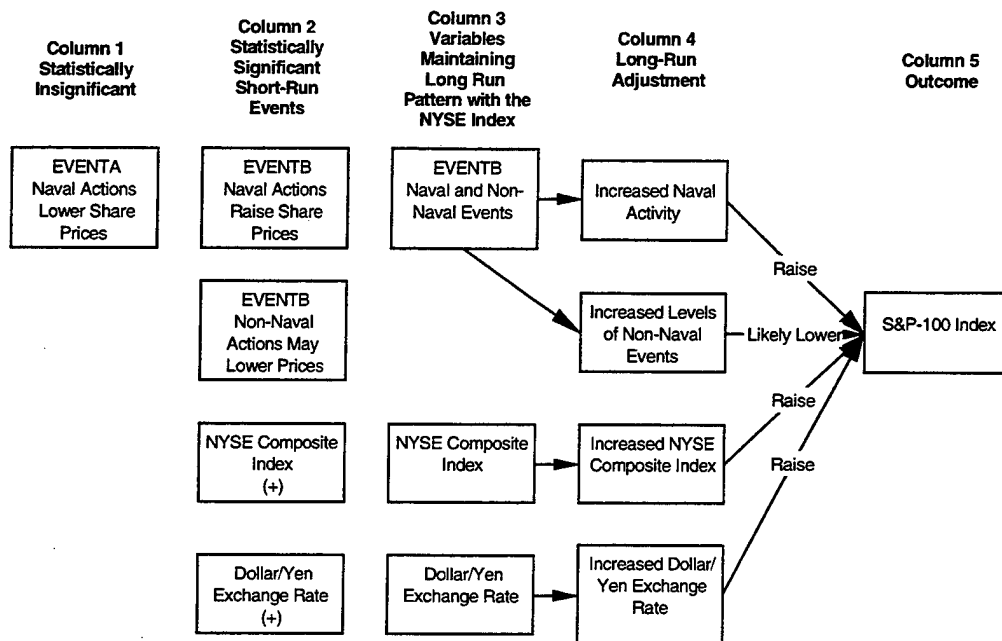
Note: Based on results from the ARDL/error correction analysis. See Figure 13 for a description of the main linkages and their interpretation.

Figure 15

Operation Desert Fox: Event Analysis of the CRB Commodity Index

Column 1
Statistically
Insignificant

Column 2
Statistically
Significant
Short-Run
Events

Column 3
Variables
Maintaining
Long Run
Pattern with The
CRB Index

Column 4
Long-Run
Adjustment

Column 5
Outcome

```
┌──────────────┐
│  EVENTA      │
│ Naval Actions│      ┌──────────────┐   ┌──────────────┐
│ Raise the CRB│      │  EVENTB      │   │  EVENTB      │   ┌──────────────┐
│ Index -Other │      │ Naval Actions│   │ Naval and Non-│──▶│ Increased Naval│
│ Events May   │      │Lower the CRB (-)│ │ Naval Activities│  │   Activity    │
│  Lower       │      └──────────────┘   └──────────────┘   └──────────────┘
└──────────────┘                                                              Lower
                      ┌──────────────┐                      ┌──────────────┐        ┌──────────────┐
                      │  EVENTB      │                      │ Increased Non-│        │CRB Commodity │
                      │ Non-Naval    │                      │ Navy Activity │─Likely Raise─│   Index  │
                      │ Actions May  │                      └──────────────┘        └──────────────┘
                      │Increase the CRB│                                           Raise
                      │   (+)        │
                      └──────────────┘
                      ┌──────────────┐   ┌──────────────┐   ┌──────────────┐
                      │Goldman-Sachs │   │ Goldman Sachs│   │ Increase in the│
                      │Commodity Index│  │Commodity Index│──▶│ Goldman Sachs │
                      │   (+)        │   └──────────────┘   │    Index      │
                      └──────────────┘                      └──────────────┘
```

Note: Based on results from the ARDL/error correction analysis. See Figure 13 for a description of the main linkages and their interpretation.

46

Figure 16

Operation Desert Fox: Event Analysis of the Goldman-Sachs Commodity Index

Column 1 Statistically Insignificant	Column 2 Statistically Significant Short-Run Events	Column 3 Variables Maintaining Long Run Pattern with The GSA Index	Column 4 Long-Run Adjustment	Column 5 Outcome

EVENTA
Naval Actions Raise the GSA Index -Other Events May Lower

EVENTB
Naval Actions Lower the GSA (-)

EVENTB
Non-Naval Actions May Increase the GSI (+)

NYMEX Oil Price (+)

EVENTB
Naval and non-Naval Events

Increased Naval Activity

Increased Non-Navy Activity

Lower

Likely Raise

Goodman Sashes Commodity Index

Raise

NYMEX Oil Price

Increase in NYMEX Crude Oil Price

Note: Based on results from the ARDL/error correction analysis. See Figure 13 for a description of the main linkages and their interpretation.

V.4 Oil Market Developments

The Financial Times accounts of this period (Paul Solman, "Oil Prices Slipped Yesterday in Spite of Continued Military Action in the Gulf," Financial Times, December 18, 1998, p. 34; Robert Corzine, "Slide in Crude Surprises All," Financial Times, December 24, 1998, p. 20) suggest that the outlook for a sustained price increase was uncertain at best. According to that source, the factors that triggered and exacerbated the price declines in 1997 - a collapse in Asian demand due to the regional financial crisis, rising Iraqi exports, an uncertain global economic

outlook, a surplus of crude oil and refined products and erratic compliance by members of the Organization of Petroleum Exporting Countries to promised production cuts – had not yet dissipated.

The view among oil companies was generally bearish (Paul Solman, "Oil Prices Continue to Drift Downward," Financial Times, December 11, 1998, p. 30; Paul Solman, "Outlook for Oil Remains Uncertain," Financial Times, January 2, 1999, p. 8; Robert Corzine, "Prospects for Firmer Prices Uncertain," Financial Times, January 29, 1999, p. 3). Most appeared resigned to a prolonged period of low crude prices, with some even arguing that the present downturn might be much more than merely the rock bottom of the commodity cycle. Many thought that the global industry might be facing a fundamental restructuring and realignment, with low-cost producers, especially those in the Middle East, likely to reassert their dominance in coming years at the expense of higher cost areas, such as onshore North America and the North Sea.

V.5 Economic Benefits

Key Dates

December 8, 1998
Chief UN weapons inspector Richard Butler reports that Iraq is still impeding inspections. UN teams begin departing Iraq. Prior to this date the oil markets had been relatively calm with only minor changes in the NYMEX over the period December 2 through the 8th. Also, on December 8 the spot was just slightly below the first forward contract indicating the markets had little concern over supply availabilities. This is evidenced by the general pattern of forward rates gradually sloping upward during this period. There was never an extremely high premium for earlier rather than later delivery (downward sloping forward profiles) as had characterized the period right after the invasion of Kuwait (Desert Storm).

December 9, 1998
Starting on the 9th however, the spot started trading at a considerable premium vis-a-vis the first forward contract. See Figure 17. It is therefore fairly safe to say that the markets were in short-run equilibrium on the 8th , only to become somewhat alarmed by deteriorating conditions after that date.

December 16, 1998
A formal UN report accuses Iraq of a repeated pattern of obstructing weapons inspections. As the chart below indicates, however, the spot market was considerably below the first forward suggesting little concern over availability of deliveries. This is also borne out by the generally negative values for the first-second forward contracts during the period.

December 17, 1998
The United States and Great Britain begin a massive air campaign principally involving naval forces. Oil markets react with a sharp increase in the spot rate.

December 20, 1998
President Clinton suspends military action against Iraq after a fourth day of air strikes, saying the "operation is now complete." The markets appear to have equilibrated quickly on the first subsequent day of trading (Monday, December 21, 1998).

V.5.1 Assumptions

These developments and movements in the oil markets suggest two possible sets of dates for calculating economic benefits associated with naval forward presence/crisis response:

- The first set (Measure A) covers the period December 8 through the 21—from the first sign of a crisis to the time the crisis was resolved through naval action. The fact that oil markets were tranquil at the time suggests that this measure may be a slight underestimate of the benefits derived from naval action.

- The second set (Measure B) covers the period December 16 through the 21—from the first sign that actual fighting might erupt to the time the crisis was resolved through naval action. Given some of the elevated price at this date was no doubt caused by the anticipation of a conflict, this measure overstates the economic benefits derived from naval action.

Figure 17

NYMEX: Spot and Forward Patterns

Legend
—▲— Spot-First
···■··· First-Second
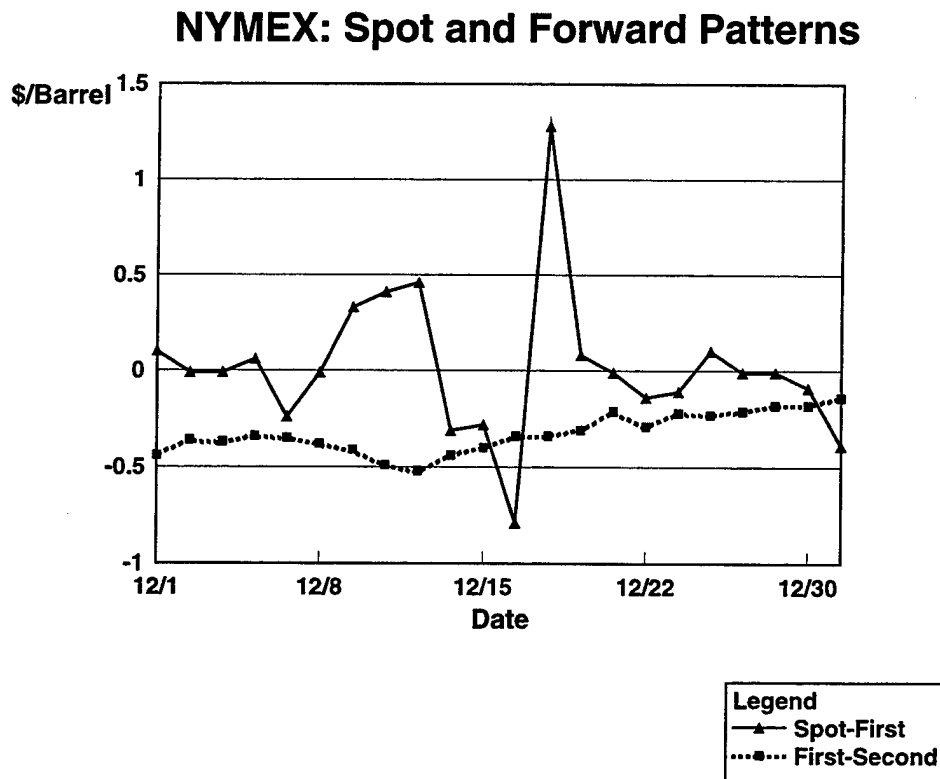
Using these intervals, a VAR forecasting model of the US economy was constructed. Statistical tests indicated that both the NYMEX spot market and the dollar/yen exchange rate

49

were significant in affecting the manner in which the crisis impacted US GDP. In the estimates below (Table 4), the oil impact was calculated first and a second set of calculations undertaken to see how movements in the dollar/yen rate by itself might have impacted on the economy. A final set of calculations combines the oil price movements with that of the dollar/yen rate. The result of this combination is not a simple additive amount as each may have negated the other during certain quarters. The final estimate does however provide a rough range of benefits associated with naval action during the period.

V.5.2 Findings

While the findings in Table 4 show benefits that are most likely in the range of three billion 1995 dollars (Table 4, Model III), there are some biases built into the analysis. For one thing, given data limitations, the impact of the operation can only be measured through 1999 thus no doubt biasing the results downward somewhat.

The second problem is that one gets a somewhat different picture if just the oil price effect (NYMEX) is used versus using both the NYMEX and the dollar/yen exchange rate. The VAR Model analysis suggests that both variables should be used in the economic benefit calculations. However, no direct statistical link was found between events and the dollar/yen exchange rate while a strong one existed with the NYMEX. If one accepts the event analysis finding and leaves the dollar/yen rate out of the VAR then the benefits lie between 1.1 and 3.6 billion 1995 dollars, Table 4, Model I. A conservative estimate therefore places the benefits at between 1.1 and 3.6 billion (1995) dollars.

V.6 Conclusions

As with the Taiwan Strait case, the analysis has found strong stabilizing effects between naval actions and a number of key markets. There is a striking similarity to the two sets of results in that key naval actions provide a stimulus to share markets while retarding the upward movement in oil and commodity prices. As with the Taiwan strait case one can only interpret the results as suggesting that the markets look at naval forward presence and crisis response as a stabilizing force, providing security of supply and continued access to supplies. They are not viewed as ushering in a period of protracted instability and uncertainty.

Table 4

Operation Desert Fox:
Naval Crisis Response Impact on the United States Economy

(Billions 1995 Dollars)

	Measure A	Measure B
Model I – Oil Price Effect		
Date		
1999Q1	0.1	0.5
1999Q2	0.2	0.7
1999Q3	0.3	1
1999Q4	0.5	1.4
Impact Through 1999	1.1	3.6
Model II – Yen Effect		
Observation		
1999Q1	0.5	0
1999Q2	0.8	0.1
1999Q3	1	0.1
1999Q4	1.2	0.1
Impact Through 1999	3.5	0.3
Model III – Combined Oil/Yen Effect		
Observation		
1999Q1	0.5	0.4
1999Q2	0.7	0.6
1999Q3	0.9	0.9
1999Q4	1.1	1.2
Impact Through 1999	3.2	3.1

Notes: The statistical output of the ARDL/error correction analyses and VAR models on which these results are based are contained in a separate set of appendices available from the authors.

Order of VAR = 2.

Model I – Oil price effect examines just the impact of oil price changes on US GDP; Model II – Yen effect assess the impact on US GDP due exclusively to movements in the Japanese Yen; and Model III – Combined oil/yen effect examines the simultaneous impact of oil price and yen changes on US GDP.

Impact Measure A is derived by subtracting the US GDP estimated on the assumption of December 8 oil and dollar/yen forward prices from that estimated on the basis of December 21 prices.

Impact Measure B is derived by subtracting the US GDP estimated on the assumption of December 16 oil and dollar/yen forward prices from that estimated on the basis of December 21 prices.

VI. Operation Attain Document 1

VI.1 Overview

This case, occurring through much of January 1986, is the first of four operations conducted off the coast of Libya that year, ending with Operation El Dorado Canyon, April 15, 1986.

VI.2 Timeline

January 7, 1986

President Reagan issues an executive order banning travel, trade, or other transactions with Libya. A February 1st deadline is set for the withdrawal of 1,000 Americans ordered to leave as part of the US economic sanctions.

January 13, 1986

Two LAAF Mig-25's intercept an EA-3B 150 NM North of Libya.

January 15, 1986

The aircraft carriers USS Coral Sea and USS Saratoga arrive on station in the Mediterranean with 13 other US Navy ships.

January 24, 1986

Carrier operations begin in the central Mediterranean Sea. The New York Times (Bernard Gwertzman, "U.S. Navy Starting Flights off Libya," New York Times, January 24, 1986, p. 8) reported that the American Navy off Libya has informed Tripoli air controllers that planes from two aircraft carriers will be carrying out maneuvers for one week. Also, it was timed for the end of the mission to Western Europe by John C. Whitehead, Deputy Secretary of State, who has been urging allies to take measures against Libya in response to the terrorist attacks on the Rome and Vienna airports on Dec. 27. The United States contends that the Abu Nidal group carried out the attacks, and that that group has received training and support from Libya.

January 25, 1986

Qaddafi declares 32 30N the "line of death" as he boards the PT boat Waheed to travel from Misratah to Bengazi along 32 30 N in defiance of scheduled US naval exercises to the North. New York Times (Judith Miller, "Qaddafi Says he has Called Full Alert," New York Times, January 25, 1986, p. 4) reports that the dollar fell to a seven-year low in Tokyo and declined in Europe after Japan's Finance Minister predicted that the currency would fall to the 190-yen level. Gold prices surge in what traders called a reaction to the falling dollar and to uneasiness over American naval maneuvers off Libya's coast. Demand for gold tends to increase during times of political uncertainty. Navy carrier jets begin operations north of Libya, leaving t open the possibility that the Navy jets from the carriers Coral Sea and Saratoga might be ordered into airspace over the Gulf of Sidra, thereby risking a clash with Libyan forces.

<u>January 26, 1986</u>

Operation Attain Document I begins north of 32 30. USS Saratoga and USS Coral Sea conduct flight operations in international waters to demonstrate US right to operate there. The New York Times (Judith Miller, Qaddafi Sails off to Confront U.S. Warships," New York Times, January 26, 1986, p. 1) reports multiple intercepts of LAAF aircraft north of 32° 30'N over the next four days.

<u>January 28, 1986</u>

New York Times (Bernard Gwertzman, State Dep. Official Warns Libyans (New York Times, January 28, 1986), p. 8) reports that NBC News had been informed by Pentagon officials that the Navy planned to move a vessel, probably the cruiser Yorktown, into the Gulf of Sidra. Other Pentagon officials, however, said the NBC News report was wrong. Also, a senior State Department official explicitly warned for the first time today that the Administration would consider military action against Libya if the nonmilitary sanctions already imposed by Washington fail to achieve results. Finally, many traders who bought late last week because of heightened tensions between the United States and Libya sold those positions. No direct confrontation occurred off the Libyan coast where the United States was staging naval maneuvers.

<u>January 29, 1986</u>

New York Times (Robert Suro, "Libya Makes Offer to Stem Terrorism," New York Times, January 29, 1986, p. 16) reports that Italian Prime Minister Bettino Craxi said that Col. Muammar el-Qaddafi had offered to help halt Arab terrorist operations in Europe if the United States promised not to attack Libya. The Italian Government said it received the Libyan leader's proposal this morning in a message from the Maltese Prime Minister, Karmenu Mifsud Bonnici, who has been trying to serve as an intermediary between Libya and Italy after apparently coordinated attacks on the airports here and in Vienna on Dec. 27. Additionally, A senior Administration official said the United States would make no bargain with Colonel Qaddafi, because there is no one here who would trust his word.

<u>January 30, 1986</u>

New York Times (Judith Miller, "Oil Officials are Said to Leave Libya," New York Times, January 30, 1986, p. 1) reports that about a dozen top managers of American oil companies have quietly left Libya in the last few days. Also, while the Libyan fields may be insignificant to Occidental Petroleum, it and the other American producers are crucial to Libya's economy, analysts said. Oil is Libya's only significant source of hard currency, and American companies are said to account for the production of between 350,000 and 450,000 of Libya's 1.2 million barrels of oil per day.

<u>January 31, 1986</u>

New York Times (Bernard Gwertzman, "US Oil Companies May be Exempted from Libya Curbs," New York Times, January 31, 1986, p. 1) reports that Washington is considering modifying the Libyan sanctions by giving American oil companies licenses to continue to receive some income from Libya. The licenses would prevent the Libyans from reaping a "windfall" from American companies. Crude oil and petroleum products were mixed in thin trading. Analysts said the markets were awaiting a meeting of a special committee of OPEC on Monday.

VI.3 Event Analysis

The Libyan case was selected to gain some sense as to how markets at that time responded to news concerning the potential conflict between the United States and Libya. At this time, the NYMEX market was a relative newcomer to futures trading and forward contracts. As the previous cases have shown, NYMEX forward markets play a critical role in transmitting naval events into impacts on the United States economy. Has this been the case from the start, or have these markets grown in sophistication over time with regards to the manner in which traders interpret breaking news?

As a first step, an event analysis of the early 1986 period was undertaken to determine if a valid statistical relationship existed between naval actions off the Libyan coast and the major oil, commodity, share and exchange rate markets. Specifically, at the time did these markets respond to news concerning naval actions and, if so, did they assume that a disruptive conflict would ensue? Or, instead, did they interpret naval actions as stabilizing the environment through providing increased security and certainty concerning availability and access? Alternatively, did the markets simply disregard naval events as having any particular significance? Using the time line for the Libyan operations in early January, the key events are coded to test these alternative views of naval forward presence and crisis response.

As in the previous cases, the event analysis can be used to statistically test the validity of different hypotheses concerning the manner in which markets interpret naval actions. In the case at hand, EVENTA (see Appendix F) assumes that US naval actions cause increased uncertainty in the oil markets, resulting in price increases, with other events' signs determined by their likely impact on oil prices. A positive sign suggests the markets interpret the event as creating increased uncertainty and or possible disruption, and a negative sign is indicative of markets interpreting the event as reducing tension and or the chance of supply disruption. EVENTB assumes that US naval actions result in reduced uncertainty in the oil markets, resulting in price declines, with other events' signs determined by their likely impact on oil markets. EVENTC assumes that all events and activities are seen by the oil markets as creating instability and increased uncertainty.

Using these three sets of event codes as independent variables the event analysis took the form of a cointegration/error correction regression. As noted in the Methodology section, this technique is ideal for the problem at hand because it focuses on the problem of identifying shocks to a system and the manner in which the system adjusts to those shocks. Specifically the analysis breaks down patterns over time into two components, a short-run impact and a longer-run adjustment whereby historical patterns are re-established.

VI.3.1 The NYMEX Crude Oil Market

Assessing the NYMEX crude oil markets, the statistical analysis found the significance of EVENTB (but not EVENTA or EVENTC) across different sets of independent variables. This finding suggests that oil markets respond to US naval actions in a positive manner, assuming that these events will provide stability to oil transport routes, production and the like. The result is a lowering of the price of oil following the event. The statistically significant long-run adjustment or error correction term (ecm) suggests that in addition to the short-run impact of EVENTB on the oil market, naval actions set off an adjustment process that also occurs over time. This adjustment is proportional to the difference in price between the NYMEX and the Goldman Sachs commodity index (or the CRB Index) plus EVENTB.

54

Increases in the CRB reduce the size of the ecm term and, given that term's negative sign in the NYMEX equation, increased upward pressure on the NYMEX oil price over time to restore long-run equilibrium. The EVENTB term is a bit more complicated. Since the naval events in the EVENTB term have a negative sign, their increased activity would tend to reduce the size of the EVENTB variable itself. In turn, a lower EVENTB value in the ecm equation tends to increase the size of the ecm term in the NYMEX equation. Given the negative sign on the ecm, the net effect of increased naval activity would be to reduce oil prices over time.

Summing up (Figure 18), there is a short-run oil price decline following naval events during this period. In addition naval events interact with oil markets over time to gradually bring down the prices in these markets so that they are in line with historical patterns vis-a-vis other commodity markets.

Figure 18

Libyan Operations: Event Analysis of the NYMEX Oil Markets
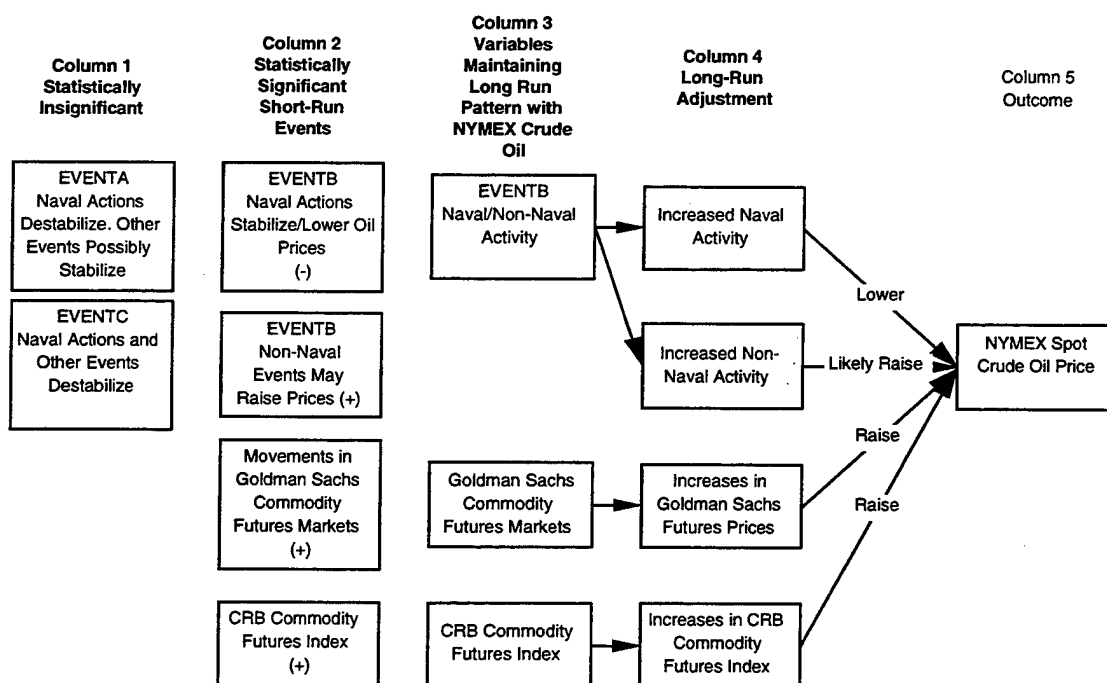
Note: Based on results from the ARDL/error correction analysis. See Figure 13 for a description of the main linkages and their interpretation.

VI.3.2 Other Event Effects on the NYMEX Oil Market

A standard measure of risk in the oil markets is the premium paid for early delivery as reflected in the spread between the first and second contract. Of the three event measures, EVENTB (negative signs on the naval events) is clearly the superior determinant of this spread. Given the negative sign on the naval events in EVENTB, it is apparent that the movement of naval forces during this episode assured markets of stable conditions thus reducing the premium of the first over the second forward contract.

Finally, the NYMEX market has historically been sensitive to unanticipated developments. As such, the daily rate often fluctuates widely depending on the market's perception of risk, availability and security of oil supplies.. Of the three event measures, EVENTB (negative signs on the naval events) is clearly the superior determinant of this spread. Given the negative sign on the naval events in EVENTB, it is apparent that the movement of naval forces during this episode assured markets of stable conditions thus reducing the magnitude of day-to-day movement of the spot rate.

VI.3.3 New York Stock Exchange Composite Index

The event analysis suggests that two event variables, EVENTB and EVENTC, affect the NYSE Composite Index (Figure 19). The t-statistics for EVENTC are slightly better suggesting that this formulation is the best for capturing the effects of the crisis on the stock market. Taking EVENTC literally, each event (positive or negative in terms of oil prices) is interpreted by investors in a manner that ceteris paribus increases the index. In EVENTB the naval events have a negative sign, and given the negative sign on the EVENTB term, tend to stimulate increases in the index. Conversely EVENTC has a positive sign and the naval events in this formulation have a positive sign. The result is that in each depiction, naval events tend, everything else equal to provide a stimulus for the market.
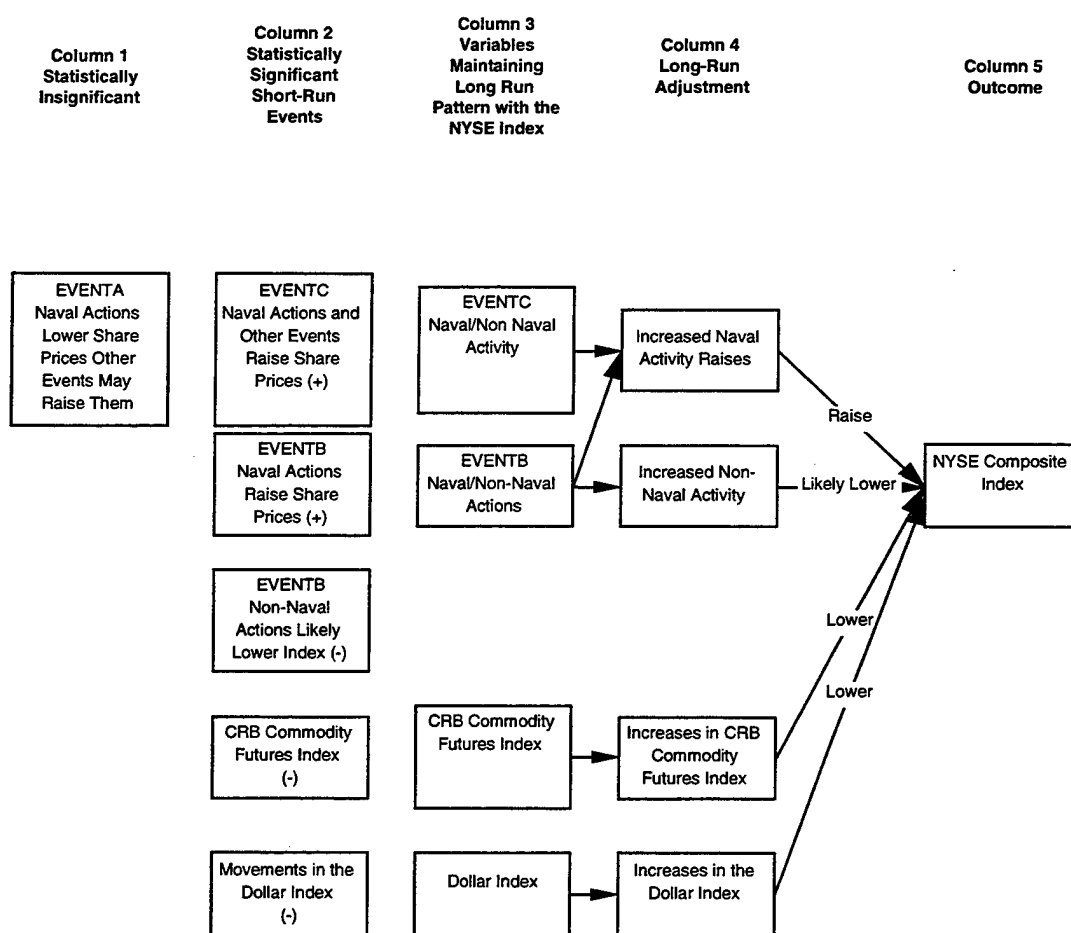
The negative sign of naval events in the EVENTB term together with that term's positive sign in the ecm suggest that naval events reduce the size of the ecm term. Given that ecm itself has a negative sign in the NYSE equation, naval events are seen as having a stimulating effect on the market during the period of adjustment following a crisis event shock. The same is true of naval events in the EVENTC term. Here naval events have a positive sign in the EVENTC series. Given that EVENTC has a negative sign in the ecm equation, naval events reduce the size of the ecm term and given that term's negative sign in the NYSE equation increase the value of the NYSE index during the period of adjustment following a shock.

VI.3.4 The CRB Commodity Index

The events surrounding the Libyan Operations of 1986 have a statistically significant link to the CRB Commodity Price Index (Figure 20). This relationship is best depicted by EVENTC (with all individual events having a positive sign). EVENTB also has several statistically significant links to the CRB. The negative sign on the EVENTC term suggests that naval events (along with other crisis events) tend to reduce the price of commodities. This is consistent with the near equivalent EVENTB, which has a positive sign in the CRB regression. Here the negative sign on naval events in EVENTB would also tend to lower the CRB Commodity index.

Figure 19

Libyan Operations: Event Analysis of the NYSE Composite Index

Column 1 Statistically Insignificant	Column 2 Statistically Significant Short-Run Events	Column 3 Variables Maintaining Long Run Pattern with the NYSE Index	Column 4 Long-Run Adjustment	Column 5 Outcome

Note: Based on results from the ARDL/error correction analysis. See Figure 13 for a description of the main linkages and their interpretation.

The forces of adjustment controlled by the ecm term reinforce these patterns. Specifically, EVENTC has a positive sign in the ecm. Here increases in EVENTC reduce the size of the ecm

57

term. Given the negative sign on the ecm term in the CRB equation, naval events reduce the upward pressure on prices. Basically the same pattern occurs with the EVENTB term. This variable has a negative sign in the ecm. However, given the negative sign for naval events in the EVENTB term, increased naval activity (given the negative sign on the ecm term in the CRB price equation) tends to reduce the CRB Commodity Index.

The effects of the event variables on the CRB differ from that found for the NYMEX and the NYSE in one important regard—there is a significant fall off in the statistical links as one moves past the last event, April 18, 1986 (the analysis covers the period to May 31, 1986). The statistical significance of the event variables in the NYSE and NYMEX did not vary much when the non-event period (April 19, 1986-May 31, 1986) was included in the analysis. This suggests that the adjustment period for the CRB Index is much shorter than for the NYSE or NYMEX.

Figure 20

Libyan Operations: Event Analysis of the CRB Commodities Index
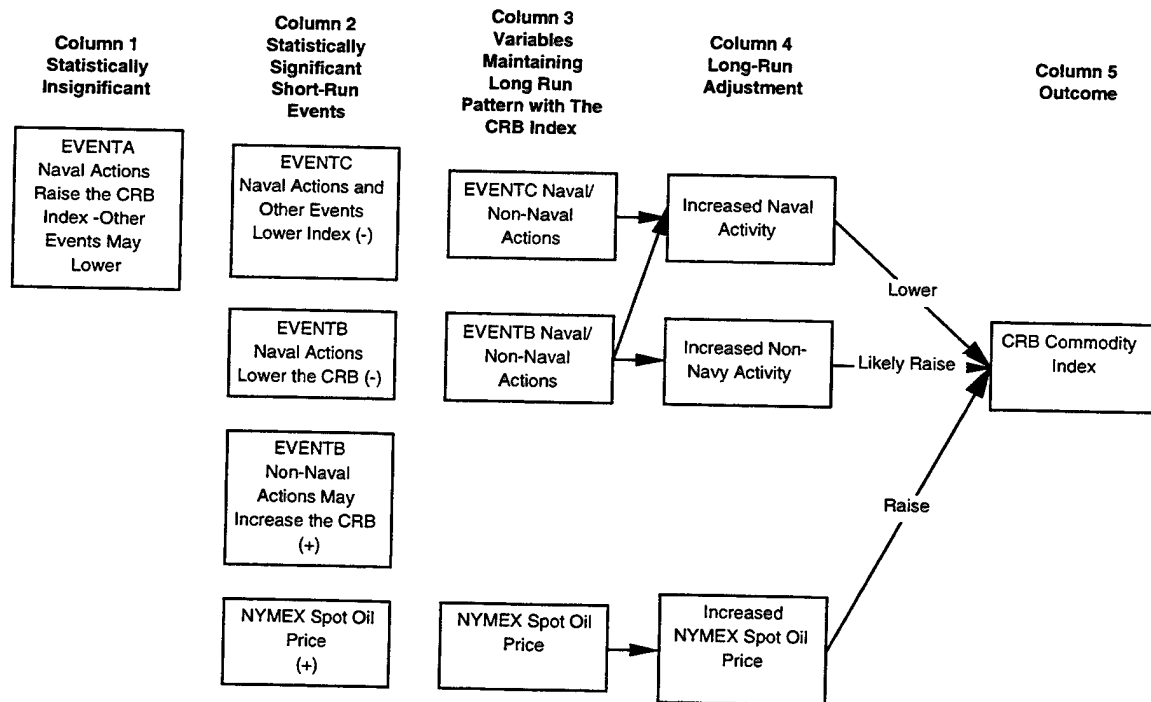
Note: Based on results from the ARDL/error correction analysis. See Figure 13 for a description of the main linkages and their interpretation.

VI.4 Economic Benefits

Due to the study's time constraints, the calculation of economic benefits was confined to Operation Attain Document I. Clearly however, given the findings presented below, there is a good chance that additional benefits would have been discovered through a thorough analysis of operations Attain Document II, Attain Document III and El Dorado Canyon.

Key dates were as follows.

January 15, 1986
USS Coral Sea and USS Saratoga arrive on station in the Mediterranean with 13 other US Navy ships.

January 16, 1986
Economic impact reflected in a drop in the NYMEX spot oil price of $1.10 per barrel.

January 20, 1986
Equilibration in oil markets with first forward contract no longer at a premium over the second contract.

January 24, 1986
Carrier operations begin in the Central Mediterranean Ocean.

January 26, 1986
Operation Attain Document I begins north of 32 30.

January 27, 1986
Monday morning short-run oil price shock resulting from initiation of operations the day before.

January 30, 1986
Operation Attain Document I ends as task force departs.

January 31, 1986
Equilibrium in the oil markets with the first and second contracts equal in price.

The event analysis suggests that during this period oil market prices declined following naval operations. Using this fact together with the forward rates (extending through the December 1986 contract) several impacts that carry on through to the US economy are identified in Table 5.

VI.4.1 Assumptions

These events and movements in the oil markets suggest four possible measures for calculating the economic benefits associated with naval forward presence and actions.

1. Initial Impact. This measure is the short-run drop in price on January 16 following the arrival of the Saratoga and Corral Sea on January 15.

2. Equilibration in Oil Markets. This measure is the restoration of the second forward contract premium over the first contract on January 20.

3. Second Impact. This measure is the start of carrier operations on January 24, at which time oil prices fell from $19.65 to $19.35 per barrel.

4. Final equilibration in Oil Markets. This measure is the achievement of equality in the first and second forward contract on January 31.

VI.4.2 Findings

The results of the economic benefit analysis (Table 5) show significant economic gains in real US GDP were derived from this operation. Taking the benefits in stages (initial and final equilibrium), a high low estimate (just looking at the impact in 1986 would have been 7.8 billion 1995 dollars, while a high estimate (impact through 1987) would have been 13.5 billion 1995 dollars. In cases such as this where the actual termination date of benefits is somewhat unclear, the low estimate is no doubt the safer of the two.

VI.5 Conclusions

Besides providing one more example of the economic benefits produced by timely naval action from forward deployed forces, this case is important because it comes at a time when the NYMEX was in the early stages of introducing forward contracts. The results clearly show that the markets were sophisticated early-on in the sense that they reflected a rational, knowledgeable, interpretation of the key crisis events. There was no panic buying or excess speculation on the unfounded notion that a regional conflict would break out. Instead the markets logically assessed the naval actions and concluded that they would aid in maintaining stability in the region.

Table 5

Operation Attain Document I:
Naval Forward Presence Impact on the United States Economy-Oil Price Effect

(Billions 1995 Dollars)

	Initial Stage of Operation		Final Stages of Operation	
	Impact (Jan15/16)	Equilibrium (Jan15/20)	Impact (Jan27/31)	Equilibrium (Jan24/31)
Period				
1986Q1	0.3	0.8	0.5	0.1
1986Q2	0.5	1.3	1.0	0.4
1986Q3	0.7	1.7	1.5	0.7
1986Q4	0.8	1.8	1.9	1.0
1987Q1	0.7	1.6	2.2	1.1
1987Q2	0.5	1.2	1.8	0.9
1987Q3	0.4	1.0	1.5	0.8
1987Q4	0.3	0.7	1.2	0.6
Impact Through 1986	2.3	5.6	4.9	2.2
Impact Through 1987	4.2	10.1	6.7	3.4

Notes: The statistical output of the ARDL/error correction analyses and VAR models on which these results are based are contained in a separate set of appendices available from the authors.

VAR=2. Variables in the VAR Model: Real Gross Domestic Product (USARGDPS), Gross Fixed Capital Formation (USAINVTS), Investment in Machinery/Equipment (USAIMCHS), Investment in Construction (USAICONS), Government Final Consumption (USAGOVTX), Intercept (INTP), NYMEX Oil Prices (NYMEX).

VAR: Optimality: SBC=2, AIC =2

Initial stages of operation: Impact 15/16 assesses the impact on US GDP by subtracting the US GDP estimated on the assumption of January 15 oil prices from that estimated on the basis of January 16 prices. Equilibrium assesses the impact on US GDP by subtracting the US GDP estimated on the basis of January 15 oil prices from that derived on the basis of January 20 oil prices

Final stages of impact: Impact 27/31 assess the impact of US GDP by subtracting the US GDP estimated on the assumption of January 27 oil prices from that estimated on the basis of January 31 prices. Equilibrium assesses the impact on US GDP by subtracting the US GDP estimated on the basis of January 24 oil prices from that estimated on the basis of January 31 prices.

VII. Globalization and Naval Forward Presence

VII.1 Introduction

When this study was undertaken, one objective was to integrate the quantitative findings of our analysis with the more qualitative approach to globalization undertaken by the National Defense University (NDU). As it turns out, the NDU study will not be released until the fall 2000. We have not been able to obtain advanced copies or preliminary results. Still scattered accounts (Dicks, "Navy Leaders Call for Boost in Budget Topline," Defense Daily, June 21, 2000) suggest that the findings of that effort are consistent with the ones presented here. In particular, a major conclusion of that study apparently will be that "the presence of Navy ships and personnel worldwide has a positive impact on trade and jobs at home."

VII.2 Components of Globalization

As usually defined, "globalization" means the process of making something worldwide in scope and application. It most commonly refers to the stunning increase in the number and variety of transnational transactions. The process of adapting to global conditions requires adjustments on the part of both producers and consumers. Specifically, globalization refers to the worldwide convergence of supply and demand. This convergence takes many forms:

- Trade (goods, services)
- Finance (banking, investment, foreign exchange, capital movements)
- Communication (information, education, technology)
- Governance (institutions, education, technology)
- Culture (art, music, entertainment) and
- Work and leisure (labor, migration, tourism).

From a purely economic perspective, there are five main trends of importance. The first trend is the upsurge of trade and changing trade linkages. During the 1985-2000 period, supported by the proliferation of multilateral and regional trade initiatives, the ratio of world trade to GDP rose approximately three times faster than in the ten years prior and twice as fast as in the 1960s. Developing countries increased their share of world trade from 23 percent in 1985 to over 30 percent in 2000. They also deepened and diversified trade linkages. Inter-developing country trade increased from 31 percent of total developing country trade in 1985 to over 40 percent by 2000. Between 1985 and 2000 the share of manufactured products in developing countries' exports increased from 47 percent to around 85 percent. A significant share of world trade is intra-firm and stimulated by FDI (foreign direct investment) as firms seek to reduce costs and tap new markets.

The second trend is the integration of world capital markets. Developing countries are becoming increasingly integrated into the global financial system, following the liberalization of financial markets of recipient and source countries. Often with the aid of the International Monetary Fund (IMF), many developing countries have removed restrictions on payments for current account transactions, and lifted controls on cross-border financial flows, especially controls on foreign inflows. The good growth performance of some developing countries has

contributed to make emerging markets more attractive to investors from advanced countries wishing to diversify their portfolios.

The third trend is the increased importance of private flows and foreign direct investment (FDI). The magnitude of private flows now overwhelms official financing. Capital inflows more than doubled in relation to developing country GDP between the early 1980s and 2000, with private capital flows rising from an annual 0.5 to 1.0 percent of developing country GDP to over 2 percent by 2000. Contributing to the rapid growth of FDI to developing countries in recent years has been the adoption of strong outward-oriented policies, including substantial improvements in their investment codes, embodying a shift from sovereign discretion to a free flow of FDI. FDI however has flowed massively towards only a few developing countries experiencing fast economic growth: for example during 1990-96 Asian countries received twice as much in percent of their GDP than African countries. Two thirds of all FDI during the last decade went to just eight developing countries, and half received almost none.

The fourth trend is the advances in telecommunications and transport. The main factor behind globalization has been the increased ease and falling cost of communications—including transportation. The cost of phone calls has fallen by a factor of sixty since 1930 and air-passenger miles per capita have increased 15 times in the last 20 years. The advent of faxes and a global computer network has brought fundamental changes in the ways businesses and governments operate.

The fifth trend is the changes in the movement of labor. As the world becomes more interconnected, flows of people across national borders have increased, though they remain small, contributing to ease labor bottlenecks and transfer managerial know-how. The largest flows are between developing countries, but flows from developing to industrial countries have accelerated over the past two decades. In the future one can expect pressures for increased migration from developing countries, whereas developed countries will lower their demand for immigrant labor.

Globalization is spreading at an uneven pace, but wherever it develops, it has important security implications. Clearly, in an economic sense it blurs national boundaries. Whether and to what extent it erodes the power of nation-states, even as it extends their sovereignty into new areas, is a controversial issue with strong arguments made pro and con. However, it clearly changes regional and international power relationships, shifts the mixture of interests at stake, and redefines long-standing alliances and conflicts. It will greatly influence the shape, content, and legitimacy of the future global security order (Strategic Assessment 1999, National Defense University, p. 19).

During the Cold War, the US consciously pursued its own version of globalization. It sought to integrate and expand the democratic, market-oriented, western or pro-western community of nations, and was not afraid of using military force to achieve the goal of spreading democracy. This community-building strategy encompassed both security and economics. The security component created a Western alliance system anchored in containment, deterrence, and collective defense. The economic component established a cooperative, rules-based trading system that rejected protectionism and lowered trade and investment barriers. Both components encouraged the notion that cooperation serves national interests better than conflict. Both stimulated greater efficiency, which freed up military and economic resources for more productive investment. In the post-Cold War era, this dual policy of expanding economic and security cooperation remains the main US policy instrument for building a just, stable, and prosperous world order (Strategic Assessment 1999, National Defense University, pp 20-22).

It is generally felt that the United States is well positioned to compete in the global economy. Economic globalization is broadly consistent with US international security and foreign policy interests. It:

- Facilitates integration
- Promotes openness
- Encourages institutional reforms
- Increases efficiency
- Accelerates the growth of US Gross Domestic Product (GDP)
- Helps control domestic inflationary forces.

VII.3 Globalization and the Economic Impact of Naval Forward Presence

Within the environment of deepening globalization, naval forward presence gives the US the ability to shape environments through the strategic positioning of people and equipment. The inherent mobility of naval forces provides the ability to rapidly project and concentrate military power worldwide, deterring and, if necessary, defeating aggression. US naval forces receive an increasing share of crisis response missions because forward deployed naval forces will be the only timely option unconstrained by access agreements.

Naval forward presence can be manifested in a number of ways, but the most common is the presence of a carrier battle group in an area of interest such as the Mediterranean Sea or the Persian Gulf. On average, 50 percent of the U.S. Navy's active fleet is underway on any given day, and more than a third is forward deployed.
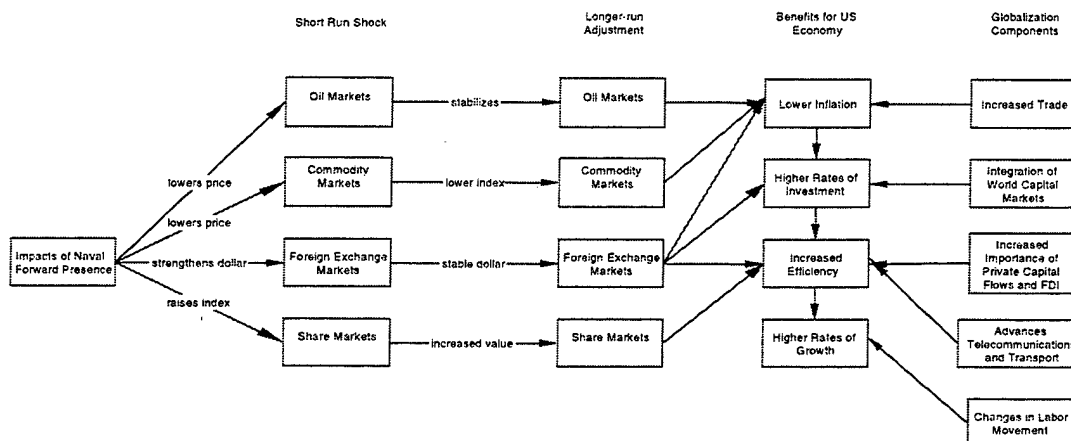
The United States is a maritime nation, and international ocean policy is important to Americans. Today, 95 percent of US foreign trade is transported by sea and it represents 20 percent of the GDP (Strategic Assessment 1999, National Defense University, p. 308). In today's global economy, any interruption in free trade, caused by a military crisis for example, has a negative economic impact, and influences a nation's well being (not only in the troubled region but worldwide). Timely responses by external military forces can stabilize the situation and restore confidence and economic activity. In the economic sense, naval forward presence provides stability and security of free trade, and quick crisis responses.

Economic benefits include the avoidance of losses GDP, reduced unemployment and inflation, expanded industrial production, etc. However, because the role of forward-deployed naval forces is primarily preventive in nature it is difficult to measure the full benefits derived from that activity. In effect, all quantitative measurements of benefits are by nature underestimates because we have no way of assessing the economic costs of the many crisis that were prevented simply because of the presence of naval forces.

With this caveat in mind the findings of the present study of four specific instances of naval forward presence and crisis response suggests that both globalization and naval forward presence complement each other in creating an environment in which the United States economy is able to fare better than would be the case if either or both were absent. These effects and linkages are summarized in Figure 22.

64

Figure 22

**Naval Forward Presence and Globalization:
Complementarities and General Impact on the United States Economy**

Short Run Shock	Longer-run Adjustment	Benefits for US Economy	Globalization Components

Impacts of Naval Forward Presence — lowers price / lowers price / strengthens dollar / raises index

Oil Markets — stabilizes — Oil Markets
Commodity Markets — lower index — Commodity Markets
Foreign Exchange Markets — stable dollar — Foreign Exchange Markets
Share Markets — increased value — Share Markets

Lower Inflation
Higher Rates of Investment
Increased Efficiency
Higher Rates of Growth

Increased Trade
Integration of World Capital Markets
Increased Importance of Private Capital Flows and FDI
Advances Telecommunications and Transport
Changes in Labor Movement

In particular the VAR forecasting models are based on the linkage from oil, exchange rate and share market shifts resulting from naval forward presence and crisis response to increased rates of investment and ultimately higher levels of GDP. While the details, role of exchange rates and share markets, may vary slightly from one case to another the basic mechanism is similar in all cases. On the globalization side of the equation (right hand column in Figure 22), a number of developments in the world market economy tend to reinforce the positive naval forward presence impact on the US economy.

It is also clear that the process of globalization can only proceed in an environment characterized by stable, secure trading conditions, provided in large part by forward deployed naval forces. Specifically (Figure 23), more stable oil prices derived from naval crisis response induce greater trade through reducing some of the risks associated with unexpected increases in transport costs. The stronger more stable dollar associated with naval forward presence aids the development of stronger US share markets (foreign investors avoid much of the exchange risk associated with other markets). The increased value in share markets associated with naval forward presence also increases investment and ultimately economic growth.

65

Figure 23

Naval Forward Presence and Globalization:
Effect of Naval Forward Presence on the Components of Increased Globalization
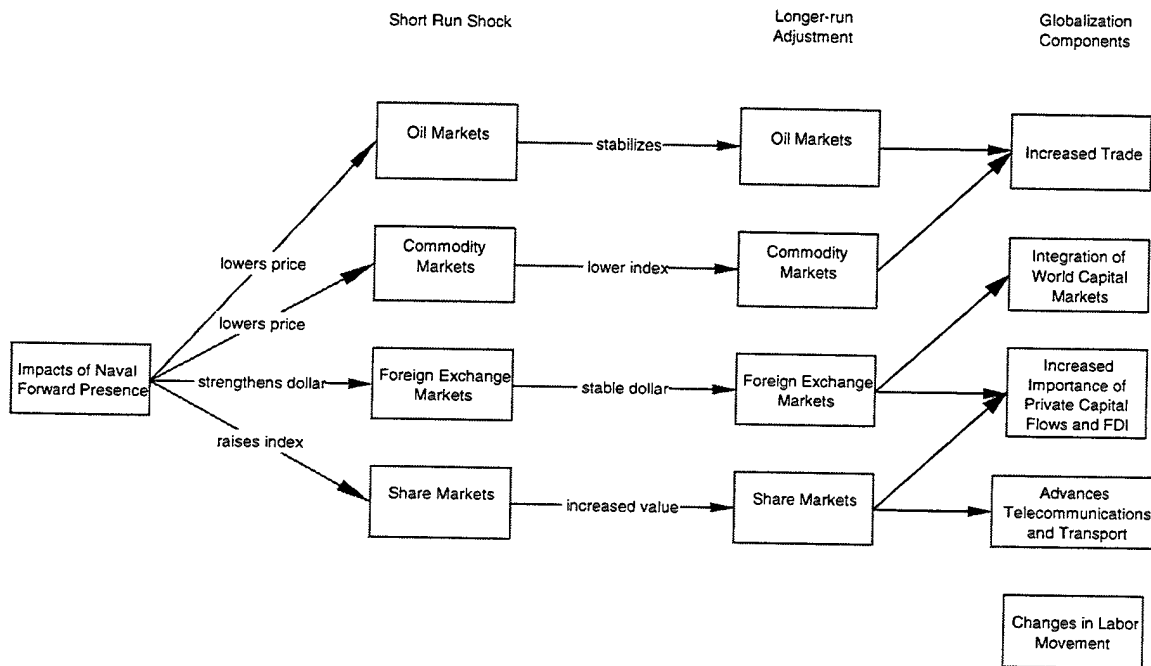
While the results of the study suggest that naval forward presence and crisis response have a strong and positive impact on the US economy, some observers have argued that in the future these impacts are likely to be diminished. For example one might argue that oil accounts for a lower share of GDP (energy conservation, alternative fuels) so that the oil shocks that have disrupted the economy in the past are becoming less and less of a threat to prosperity. A corollary is that the so-called new economy is more of a service economy and much less dependent on energy and raw materials. Despite the fact that this is a commonly held view, it is not based on any real hard evidence. Our results suggest a fairly significant oil related impact on the US economy under a series of alternative environments. While the magnitudes of each case vary greatly, there is no apparent trend towards diminished effectiveness of forward deployed naval forces in stabilizing oil markets. Finally, several recent studies avoid the new economy arguments by contending that the recent expansion in the economy is due to a good oil shock (fairly long period of low oil prices).
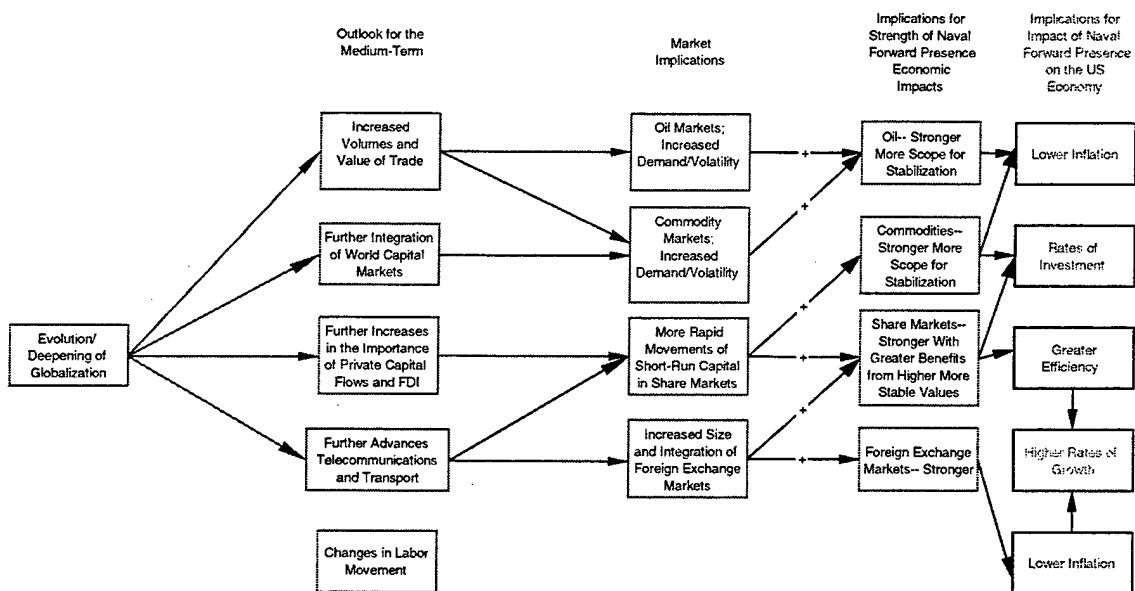
VII.4 Conclusions

As for the future, it is likely that increased world trade (Figure 24) and increased economic growth associated with globalization will place a growing demand on oil supplies

creating the chance of more volatile oil shocks associated with crisis around the world. These developments rather than lower the impact of naval forces will actually enhance the chance of favorable interventions by forward deployed naval forces. Similar arguments can be made for likely changes in the share and foreign exchange markets.

In sum, likely changes in the various facets should strengthen the economic impacts of naval forward presence and crisis response. In turn, the stability provided by naval forward presence should assure continued deepening of the globalization process. This would set up a virtuous circle that would reinforce itself over time.

Figure 24

Naval Forward Presence and Globalization:
Effect of Likely Globalization Trends on the Economic Impacts
Associated with Naval Forward Presence

VIII. Summary and Conclusions

As in the first study, all four new cases, Taiwan Strait incident and Operations Desert Strike, Desert Fox and Attain Document I, are shown to produce positive economic benefits for the United States economy. The mechanisms by which naval actions impacted on the economy are depicted in Figures 26 – 28. These benefits, measured in 1995 US dollars, are non-trivial with each operation yielding well over a billion dollars in terms of added GDP to the US economy.

Also similar to the first study, the oil markets provide a consistent link between naval actions and the US economy. This occurred despite the fact that in one case, the Taiwan Strait incident of 1996, it was not apparent that oil markets would be affected. While oil markets are the one constant throughout the cases, several other markets are affected by naval actions. These include: the dollar/yen exchange rate, the CRB commodity index, the Goldman-Sachs Commodity Index, the S&P-100, the NIKKEI 100, the Hang-Seng, and the New York Stock Exchange Composite Index.

More importantly, naval events have a positive effect at all times. In each case involving oil or commodity markets, naval events reduce the price from what it would have been in the absence of forward presence and crisis response. In the case of share markets and the dollar/yen exchange rate, prices were higher than they would have been in naval forces had not been present. In affecting these markets, naval actions are shown to produce a short-run (overnight effect) in the directions noted above. More importantly the analysis found that the impact of naval actions on these markets lingers for a significant time, altering prices for a period of time that allows for significant benefits to the US economy.

With regard to globalization, it was argued that naval events complement the positive impact increased globalization has had on the US economy. In addition, it was argued that naval forward presence and crisis response tend to strengthen the process of globalization through providing stability and security for markets.

Figure 25

Summary Measure:
Impact of Naval Forward Presence in the Taiwan Strait (1996)

Event	Markets Affected by Naval Events	Impact Naval Forward Presence on the US Economy	Summary Measure of Impact	Range of Economic Benefits

Taiwan Strait Crisis

(-) → **NYMEX Oil Market**

(+) → **Hang Seng (Hong Kong) Share Market**

(+) → **Nikkei (Tokyo) Share Market**

(+) → **Dollar/Yen Exchange Rate**

Exogenous Shock

Endogenous Variables:
(1) Private Consumption
(2) Gross Fixed Capital Formation
(3) Machinery & Equipment
(4) Construction
(5) Government Consumption

Gross Domestic Product

Probable-- $3.4 Billion (1995 dollars)

Less Likely-- $6.4 Billion (1995 dollars)

Least Likely $11.9 to 14.9 Billion (1995 dollars)

69

Figure 26

Summary Measure:
Impact of Naval Forward Presence in Operation Desert Strike (1996)

| Event | Exogenous Shocks to United States Economy | Impact Naval Forward Presence on the US Economy | Summary Measure of Impact | Initial Impact | Final Equilibrium |

Operation Desert Strike → NYMEX Oil Market, Dollar/Yen Exchange Rate (Exogenous Shock) → Endogenous Variables: (1) Gross Fixed Capital Formation (2) Machinery & Equipment (3) Government Consumption → Gross Domestic Product → Probable— $0.7 Billion (1995 dollars) → Probable— $2.0 Billion (1995 dollars); Less Likely $1.9 Billion (1995 dollars) → Probable— $4.2 Billion (1995 dollars)

Figure 27

Summary Measure:
Impact of Naval Forward Presence in Operation Desert Fox (1998)

Event	Markets Affected by Naval Events	Impact Naval Forward Presence on the US Economy	Summary Measure of Impact	Range of Economic Benefits

Operation Desert Fox

(-) → NYMEX Oil Market

(+) → S&P - 100 Index

(-) → CRB Commodity Index

(-) → Goldman-Sachs Commodity Index

Exogenous Shock

Endogenous Variables:
(1) Gross Fixed Capital Formation
(2) Machinery & Equipment
(3) Government Consumption

Dollar/Yen Exchange Rate

Gross Domestic Product

Gross Domestic Product

Most Likely Low-- $1.1 Billion (1995 dollars)

Most Likely High-- $3,6 Billion (1995 dollars)

Less Likely Low-- $3.1 Billion (1995 dollars)

Less Likely High-- $3.2 Billion (1995 dollars)

71

Figure 28

Summary Measure:
Impact of Naval Forward Presence in Operation Attain Document I (1986)

| Event | Markets Affected by Naval Events | Impact Naval Forward Presence on the US Economy | Summary Measure of Impact | Range of Economic Benefits |

Operation Attain Document I

(-) NYMEX Oil Market

(+) New York Stock Exchange Composite Index

(-) CRB Commodity Index

Exogenous Shock

Endogenous Variables:
(1) Gross Fixed Capital Formation
(2) Machinery & Equipment
(3) Government Consumption
(4) Construction

Gross Domestic Product

Most Likely Low-- $7.8 Billion (1995 dollars)

Most Likely High-- $13,5 Billion (1995 dollars)

IX. Areas for Further Research

Among other things, the current study has shown that the economic benefits associated with naval crisis response may be fairly widespread, occurring in non-oil as well as oil situations. Movements in naval forces during crisis periods often impact on a variety of markets in statistically significant ways. These movements often shock markets, initiating a follow-on equilibration process that tends to lower oil/commodity prices and raise the dollar and share market values. These movements are ultimately beneficial to the United States economy. The linkages between crisis response and markets tends to be complex with the initial impact spreading to related markets i.e., oil prices to exchange rates to share markets. The ultimate impact on the US economy as well as those of our allies is dependent on the strength and stability of these market linkages. In turn, these conditions are dependent on the environment created by the state of globalization and associated institutions.

These generalizations can be a starting point in assessing future economic impacts associated with naval forward presence and crisis response. Still, with each finding several other questions arise. Why are, say, the benefits associated with Operation Desert Fox higher than those accruing from Desert Strike? Why are the benefits from the Taiwan Strait case rather high, despite the fact that no direct links to oil exist? Would they have been higher/lower under different circumstances? Which circumstances? Can we predict, in advance, the general magnitude of economic benefits accruing from similar operations? What methods are best to do this? What factors need to be taken into account in making assessments of the impact of future naval actions? How might these change with the evolution of globalization and increased economic integration? Will likely changes in the international economic environment strengthen or weaken the positive economic impacts associated with naval forward presence and crisis response?. Ultimately, what might the US have done before and concurrently to enhance these benefits?

An issue often associated with globalization is the likelihood that the forces associated with the "New Economy" may modify the economic consequences of forward deployed naval forces. The defining characteristic of the new economy viewpoint is a focus on increasing globalization and expanding information technology as the underlying causes of an evolving economy. Here globalization and computerization are not viewed merely as symptoms of other factors but as the driving forces that are fundamentally changing the economy. On the surface this is surely true— there is little debate that the world economy is becoming more consolidated in terms of both product and capital markets and that information technology is changing how business, people and markets interact. The real questions that need to be examined are whether these changes are new in a meaningful sense and whether they are powerful enough to truly change how the economy works and thus the economic impacts of naval forward presence and crisis response. If so, what is the manner in which these changes are likely to occur, and what are the resulting consequences for the US economy?

Appendices

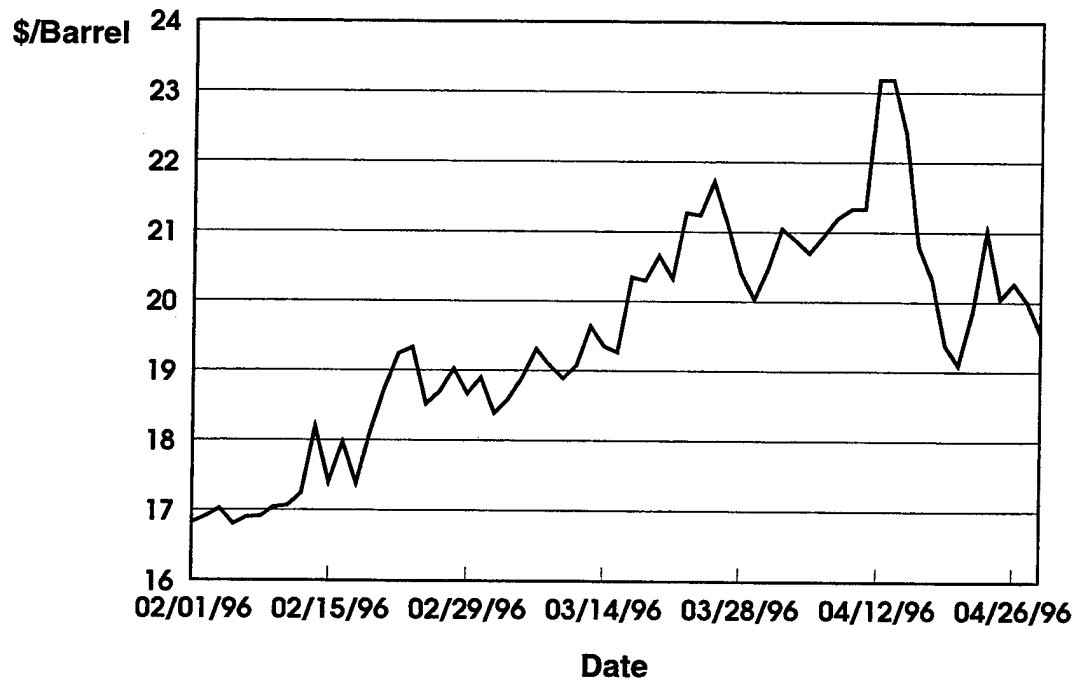Taiwan Strait Crisis: Market Movements

Figure A-1

Taiwan Crisis:
Brent Spot Market
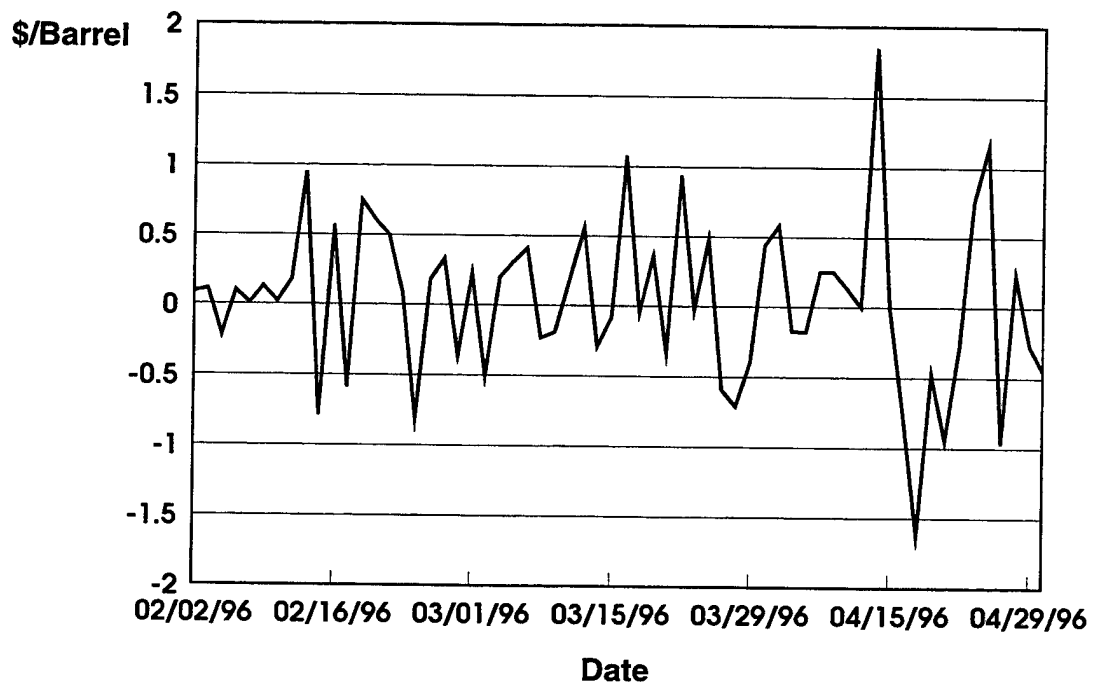
Taiwan Crisis: Daily Change in the Brent Crude Market

Taiwan Crisis: Brent Crude
Patterns of Spot and Forward Rates

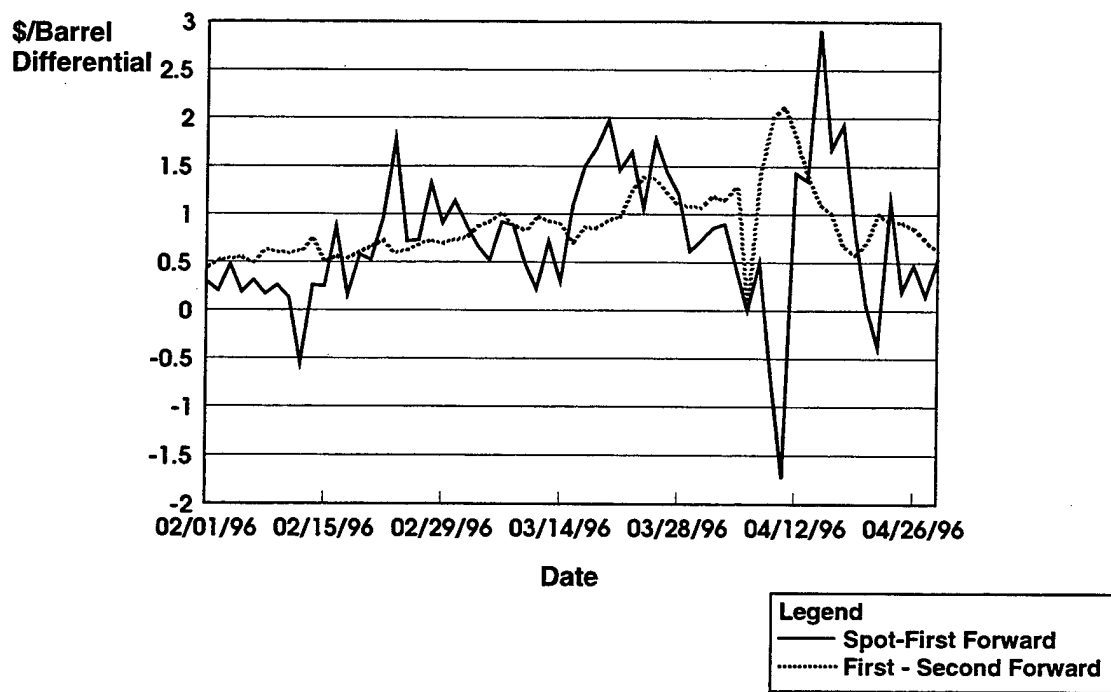**$/Barrel Differential**

Legend
——— Spot-First Forward
·········· First - Second Forward

**Taiwan Strait: Brent Markets
Profiles of Future Prices**
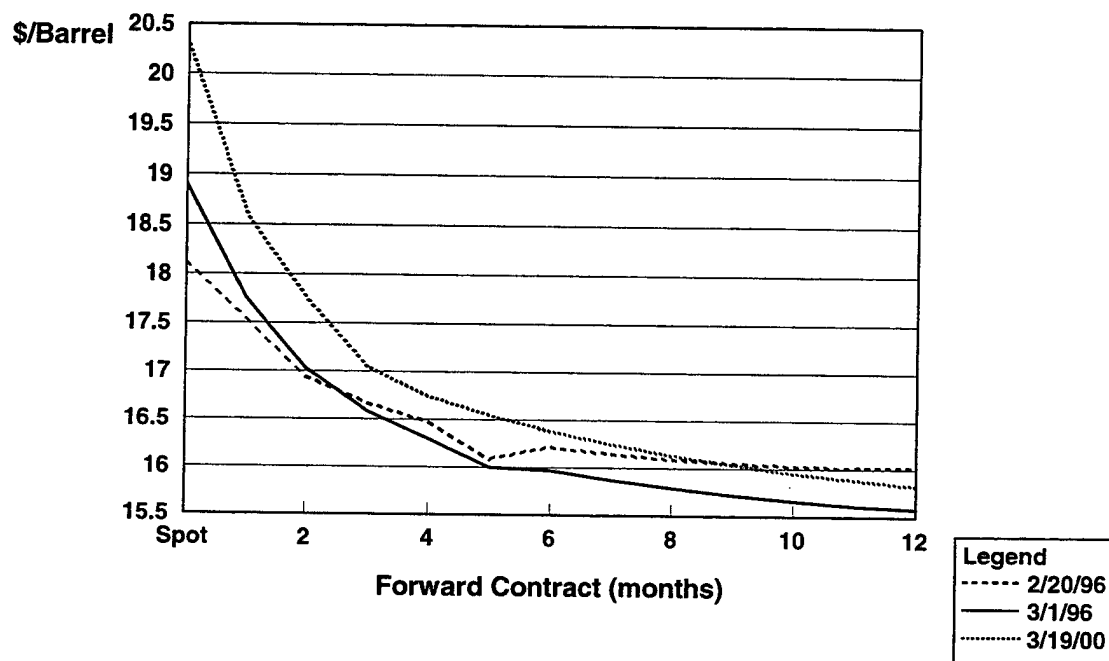
Taiwan Crisis: Oil Markets
NYMEX and Brent Spot Rates

Legend
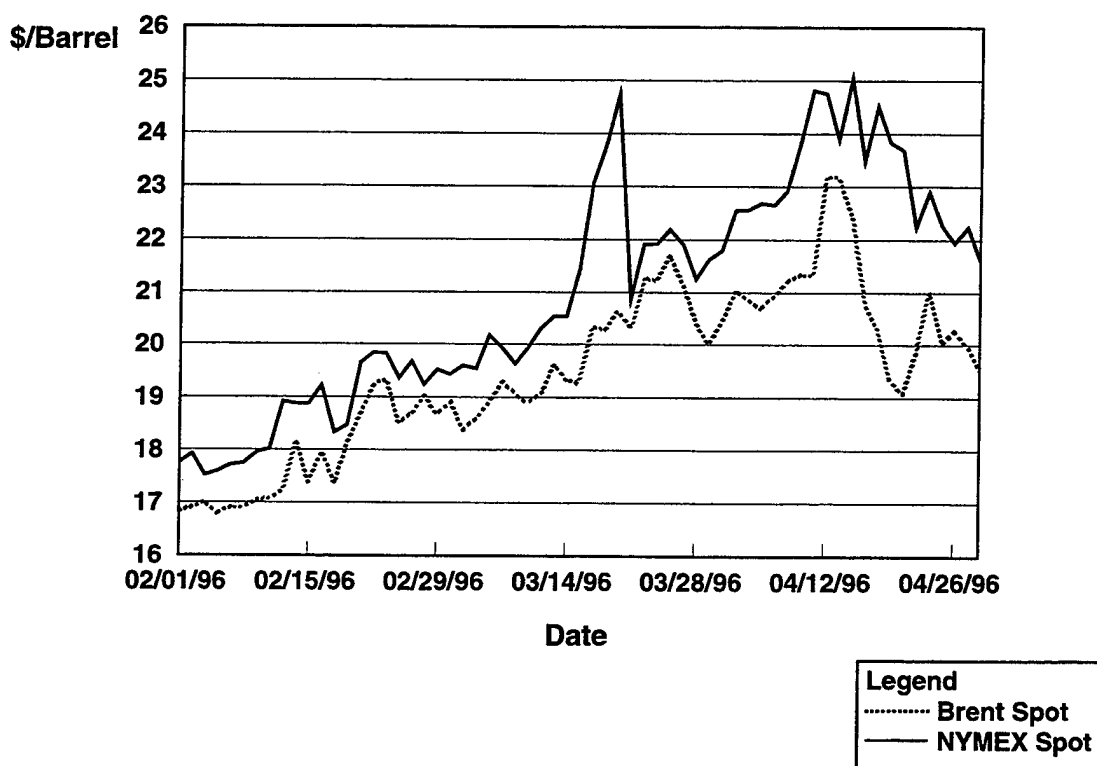············· Brent Spot
——— NYMEX Spot

Taiwan Crisis: Oil Markets
Spot/Forward Rate Patterns

Legend
·········· Brent: Spot-First Forward
——— NYMEX: Spot-First Forward
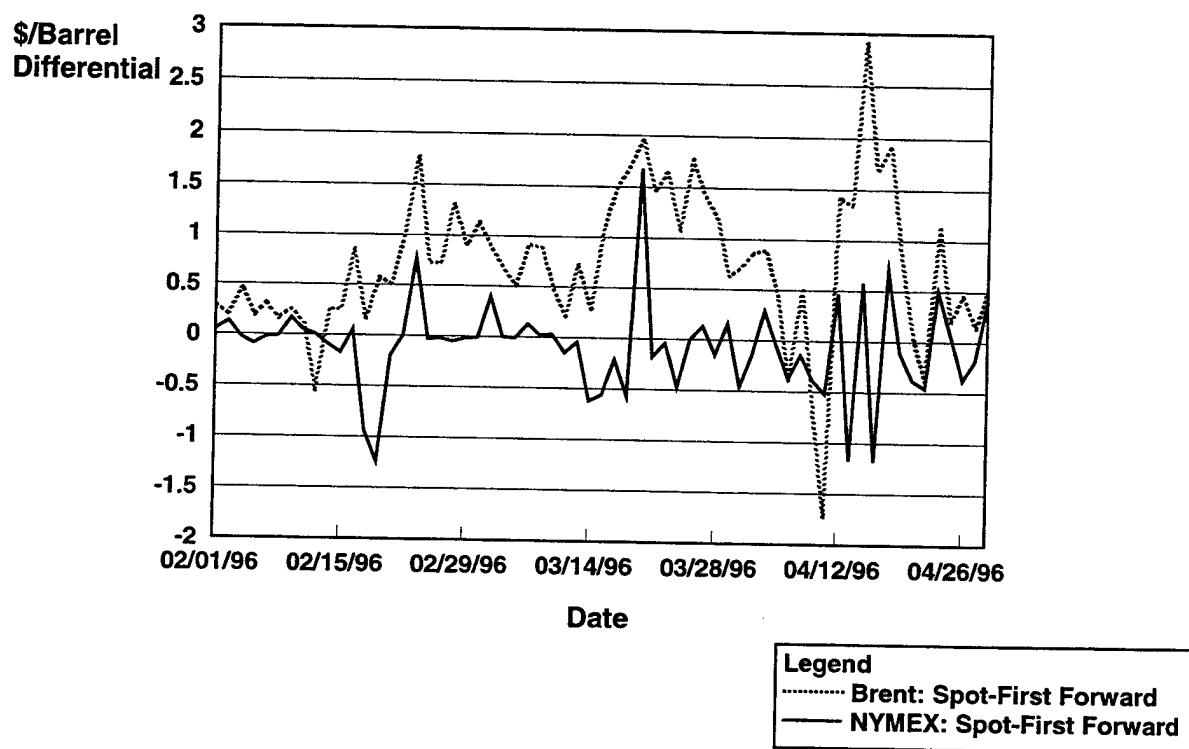
Taiwan Crisis: Oil Markets
Forward Rate Patterns

$/Barrel Differential

Legend
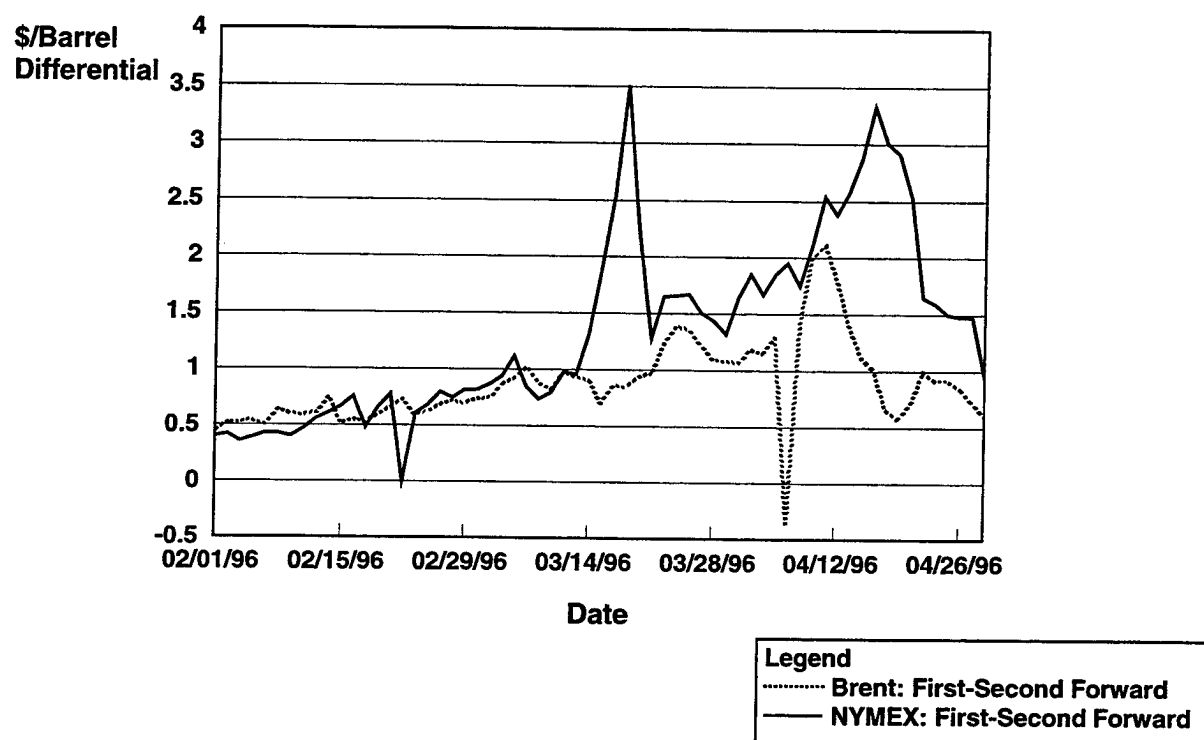---------- Brent: First-Second Forward
———— NYMEX: First-Second Forward

Taiwan Strait Crisis: Movement in the New York Stock Exchange Index
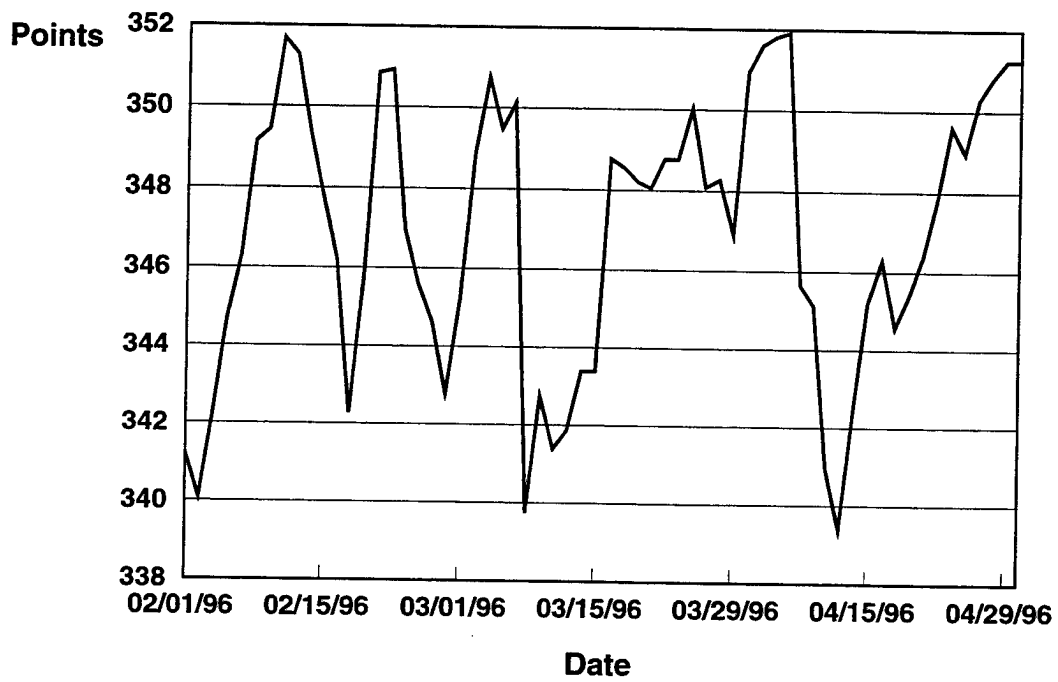
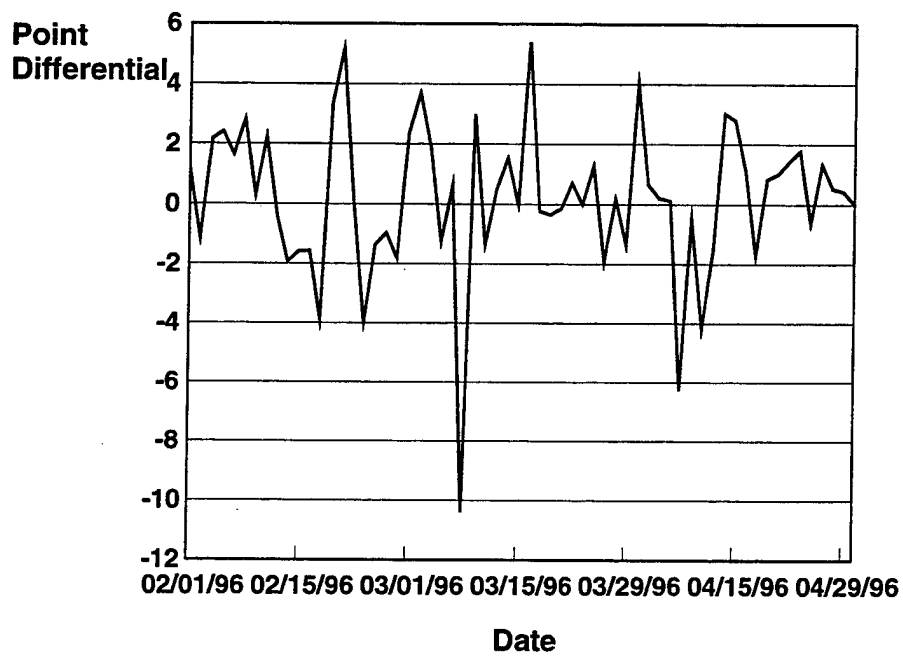# Taiwan Strait Crisis: Daily Change in the New York Stock Exchange

Taiwan Strait Crisis:
NYSE Current and Future Rates

Legend
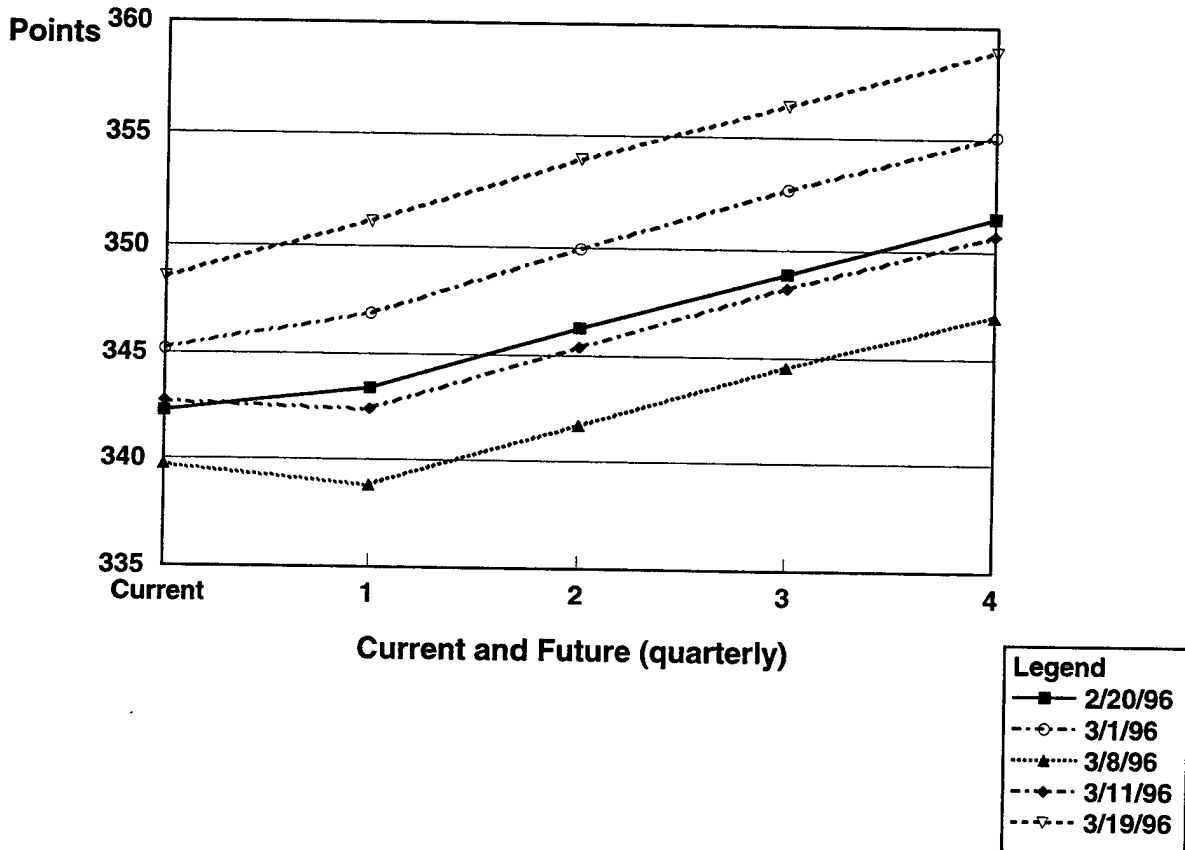—■— 2/20/96
--◇-- 3/1/96
·····▲····· 3/8/96
--◆-- 3/11/96
--▽-- 3/19/96

Taiwan Crisis:
Hang Seng Index
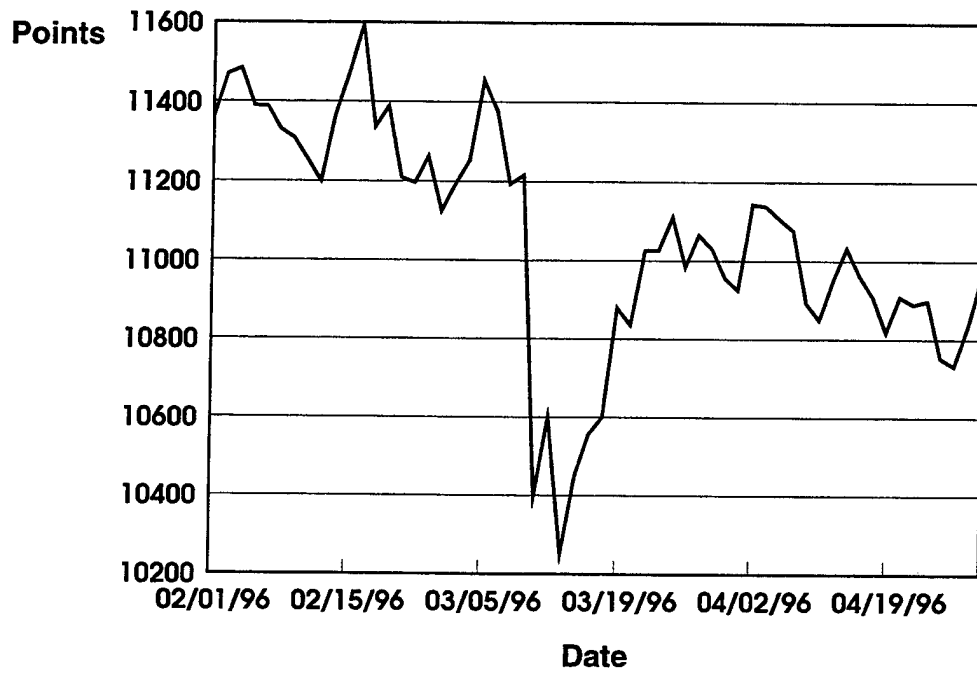
**Taiwan Crisis: Change
in the Hang Seng Index**
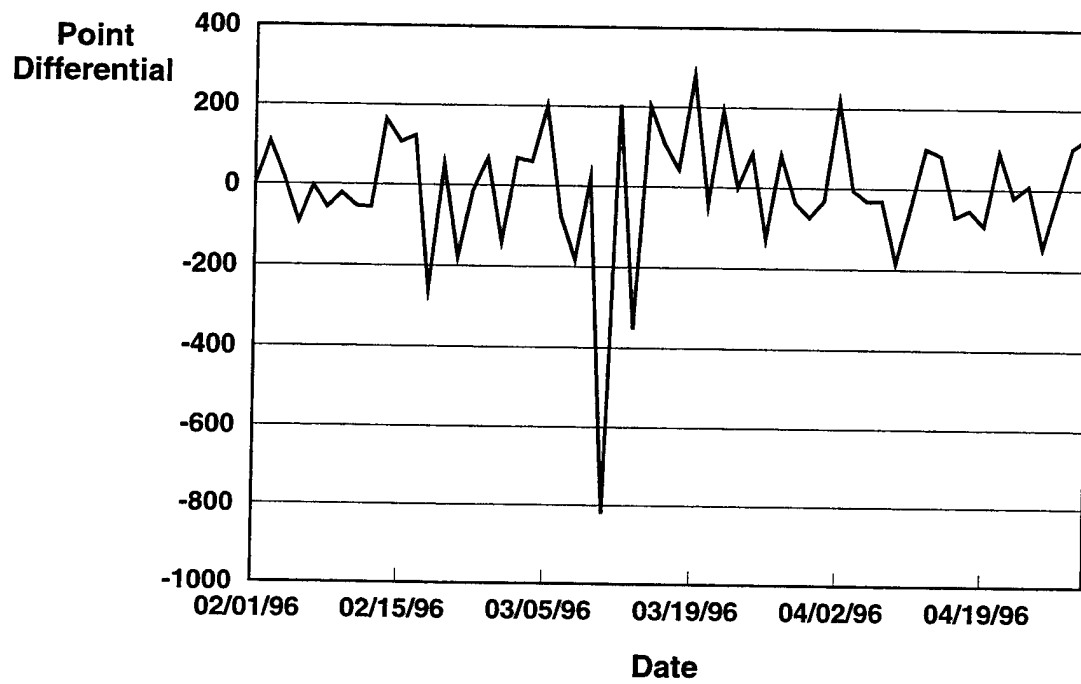
Taiwan Crisis
Movements in the FT-SE-100 Index
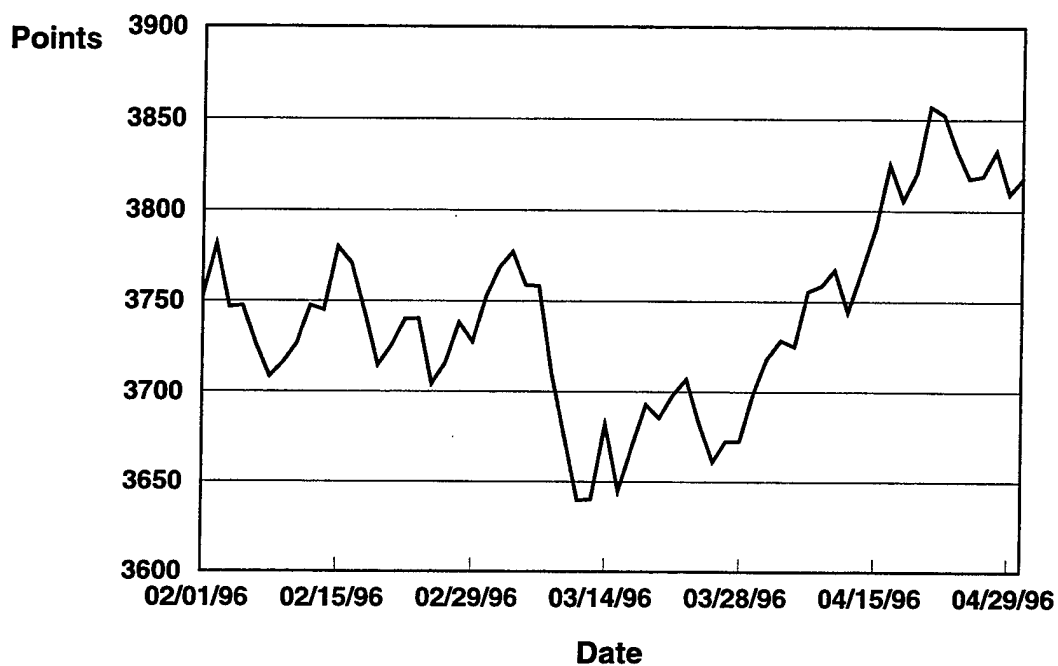
Taiwan Crisis: Daily Change
in the FTSE-100 Index
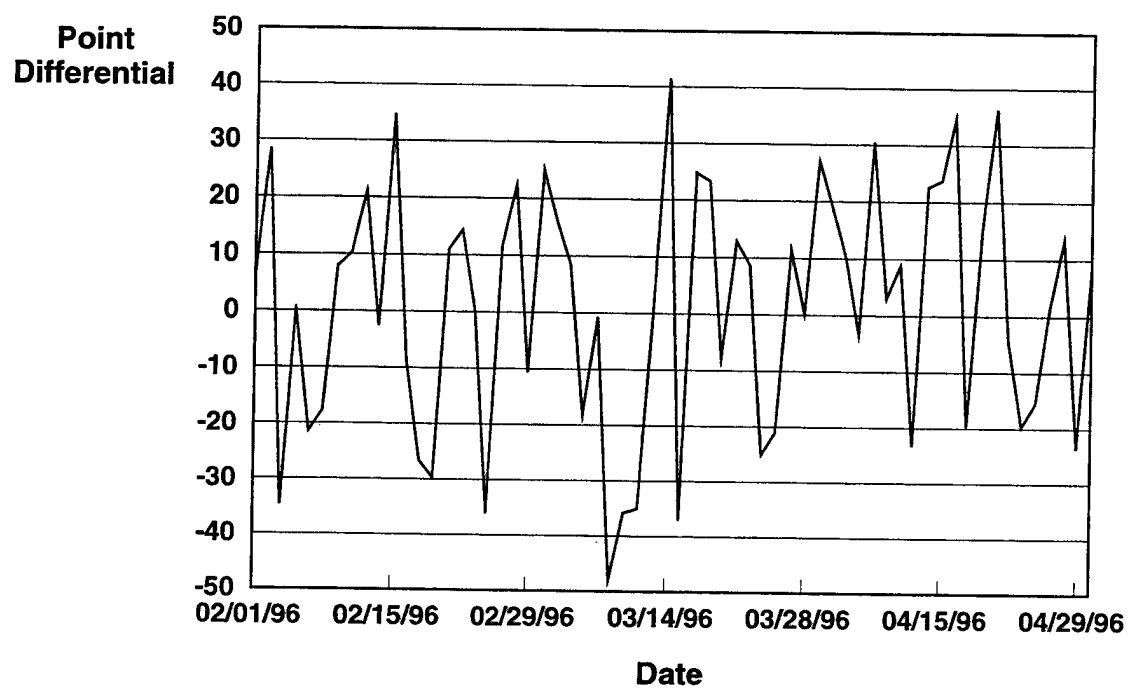
Taiwan Crisis: Movement in the Nikkei-225 Index

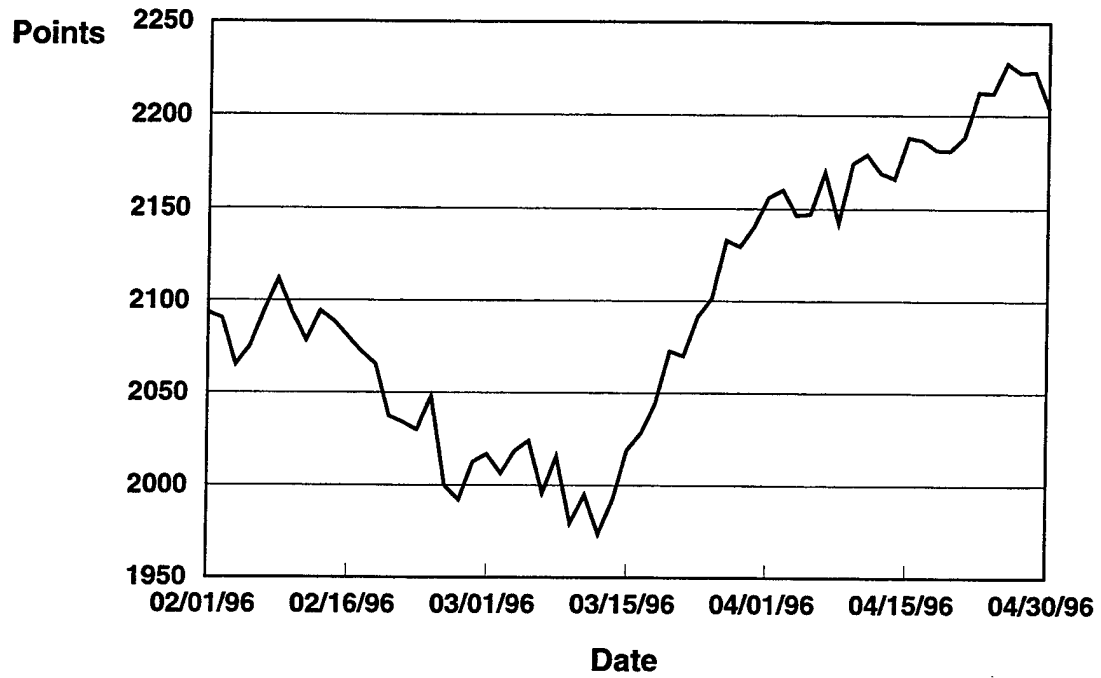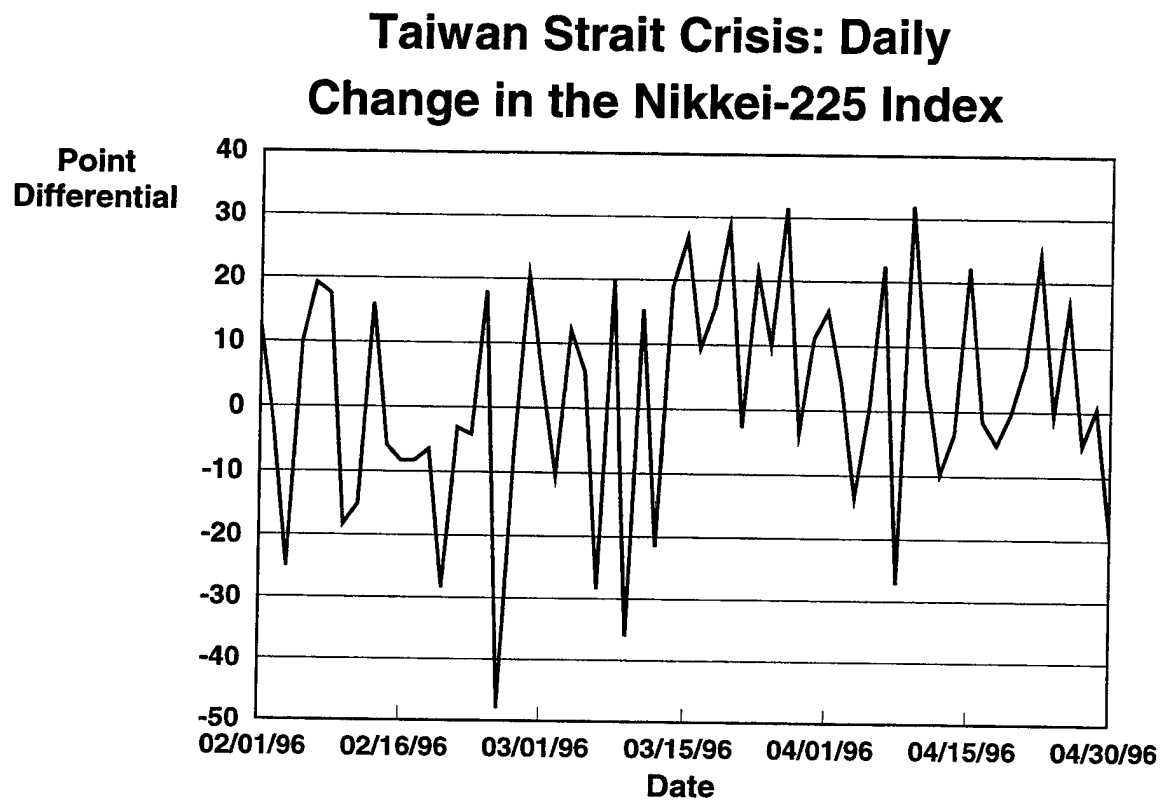# Taiwan Strait Crisis: Daily Change in the Nikkei-225 Index

Movements in the U.S. Dollar Index (Spot Rate)
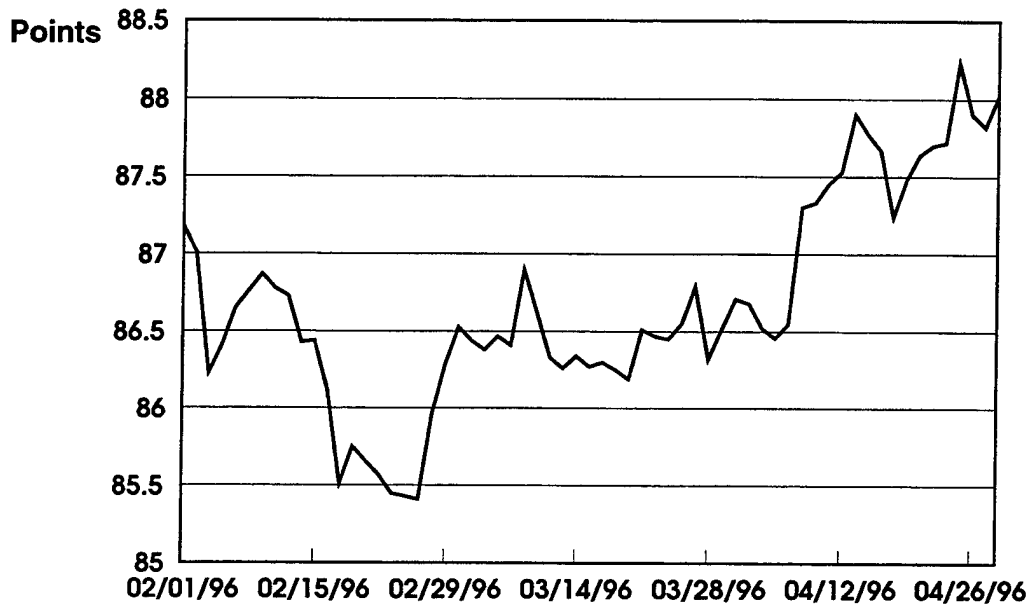
Taiwan Crisis -- Dollar Index: Change in the Spot Rate
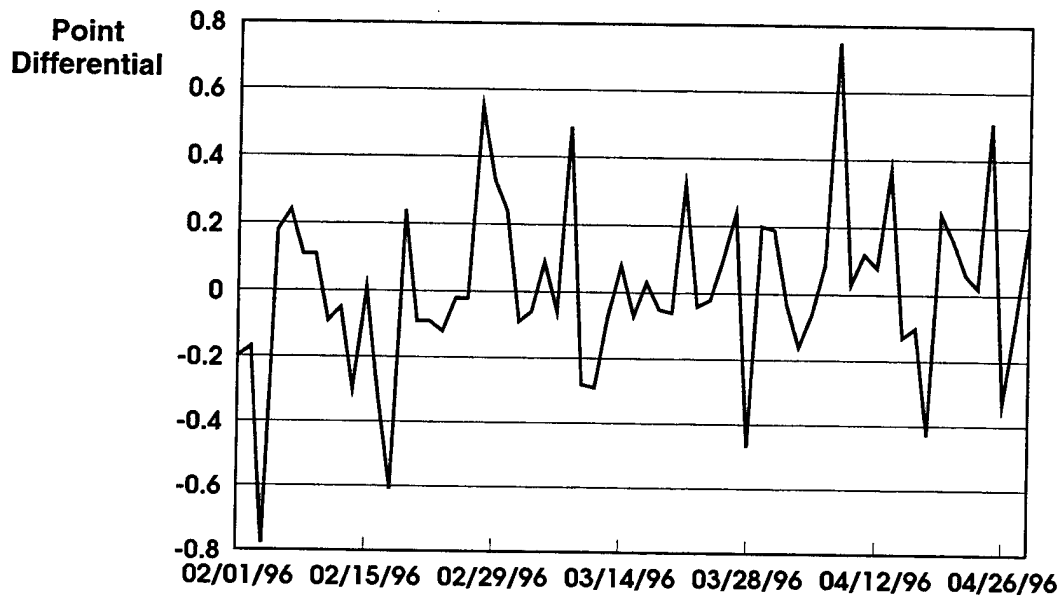
**Taiwan Crisis -- Dollar Index:
Spot and Forward Patterns**
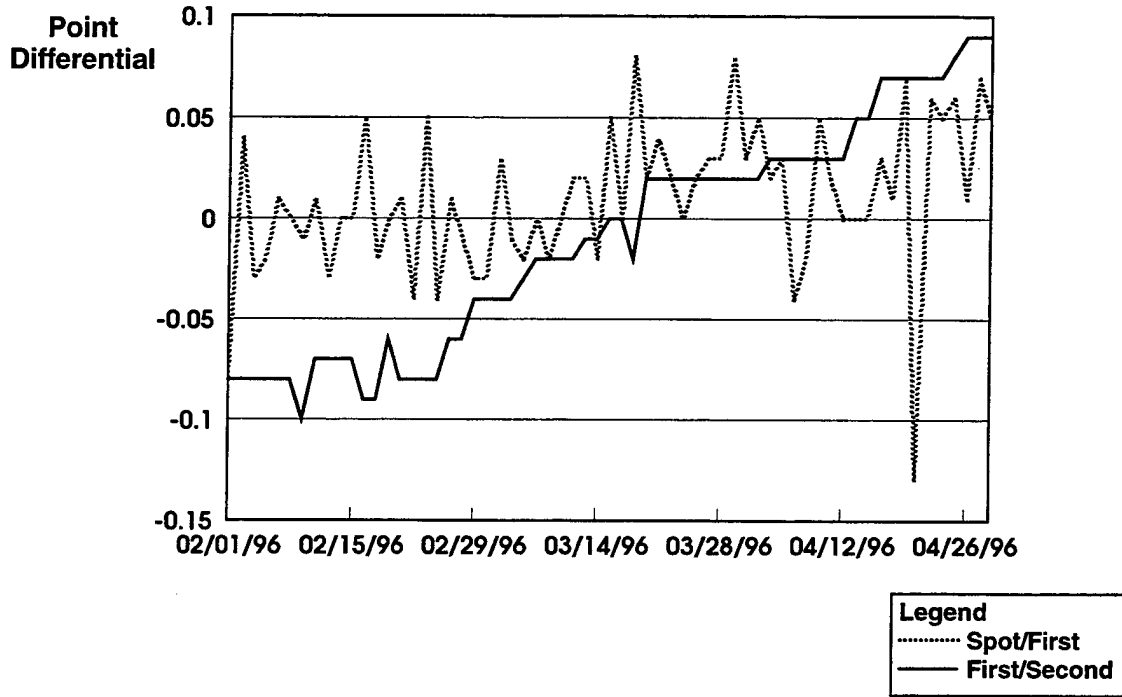
Appendix B

Table B-1

Taiwan Strait Crisis: Event Scores Assigned

Event Analysis Variables

Date	EVENT3	EVENT3A	EVENT3B	EVENT3C
12/01/95	0	0	0	0
12/04/95	0	0	0	0
12/05/95	0	0	0	0
12/06/95	0	0	0	0
12/07/95	0	0	0	0
12/08/95	0	0	0	0
12/11/95	0	0	0	0
12/12/95	0	0	0	0
12/13/95	0	0	0	0
12/14/95	0	0	0	0
12/15/95	0	0	0	0
12/18/95	0	0	0	0
12/19/95	-2	2	2	2
12/20/95	0	0	0	0
12/21/95	0	0	0	0
12/22/95	0	0	0	0
12/26/95	0	0	0	0
12/27/95	0	0	0	0
12/28/95	0	0	0	0
12/29/95	0	0	0	0
1/2/96	0	0	0	0
1/3/96	0	0	0	0
1/4/96	0	0	0	0
1/5/96	0	0	0	0
1/8/96	0	0	0	0
1/9/96	0	0	0	0
1/10/96	0	0	0	0
1/11/96	0	0	0	0
1/12/96	0	0	0	0
1/15/96	0	0	0	0
1/16/96	0	0	0	0
1/17/96	0	0	0	0

Notes: See case timeline for a listing of individual events by date.

Table B-2

Taiwan Strait Crisis: Event Scores (contd)

Date	EVENT3	EVENT3A	EVENT3B	EVENT3C
1/18/96	0	0	0	0
1/19/96	0	0	0	0
1/22/96	0	0	0	0
1/23/96	3	3	3	3
1/24/96	-2	-2	-2	2
1/25/96	0	0	0	0
1/26/96	0	0	0	0
1/29/96	0	0	0	0
1/30/96	0	0	0	0
1/31/96	0	0	0	0
2/1/96	0	0	0	0
2/2/96	0	0	0	0
2/5/96	0	0	0	0
2/6/96	0	0	0	0
2/7/96	0	0	0	0
2/8/96	0	0	0	0
2/9/96	3	3	3	3
2/12/96	0	0	0	0
2/13/96	0	0	0	0
2/14/96	0	0	0	0
2/15/96	0	0	0	0
2/16/96	0	0	0	0
2/19/96	0	0	0	0
2/20/96	0	0	0	0
2/21/96	0	0	0	0
2/22/96	0	0	0	0
2/23/96	2	2	2	2
2/26/96	0	0	0	0
2/27/96	0	0	0	0
2/28/96	1	1	1	1
2/29/96	0	0	0	0

Table B-3

Taiwan Strait Crisis: Event Scores (contd)

Date	EVENT3	EVENT3A	EVENT3B	EVENT3C
3/1/96	0	0	0	0
3/4/96	0	0	0	0
3/5/96	2	2	2	2
3/6/96	0	0	0	0
3/7/96	0	0	0	0
3/8/96	3	3	3	3
3/11/96	3	3	3	3
3/12/96	2	2	2	2
3/13/96	1	1	1	1
3/14/96	2	2	2	2
3/15/96	0	0	0	0
3/18/96	1	1	1	1
3/19/19	1	1	1	1
3/20/96	0	0	0	0
3/21/96	0	0	0	0
3/22/96	-3	-3	3	3
3/25/96	0	0	0	0
3/26/96	-3	-3	-3	3
3/27/96	0	0	0	0
3/28/96	0	0	0	0
3/29/96	0	0	0	0
4/1/96	0	0	0	0
4/2/96	0	0	0	0

Operation Desert Strike: Market Movements

Figure C-1

Operation Desert Strike:
Daily Change in the NYMEX Spot Price
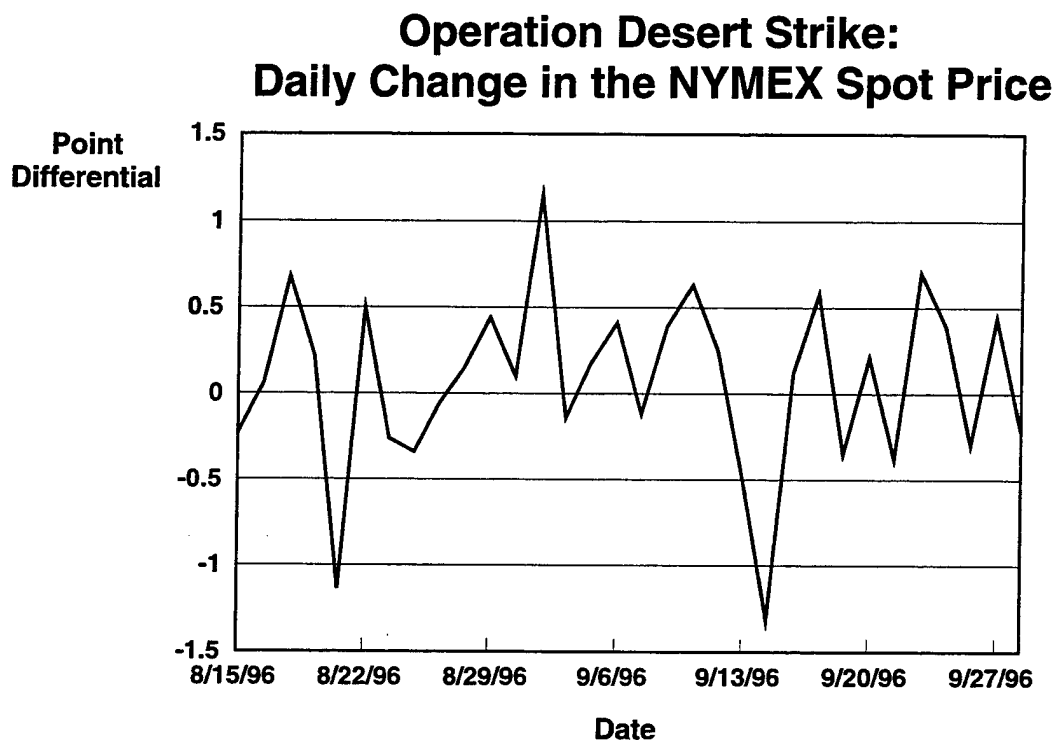
Figure C-2

Desert Strike:
NYMEX Oil Daily Volatility
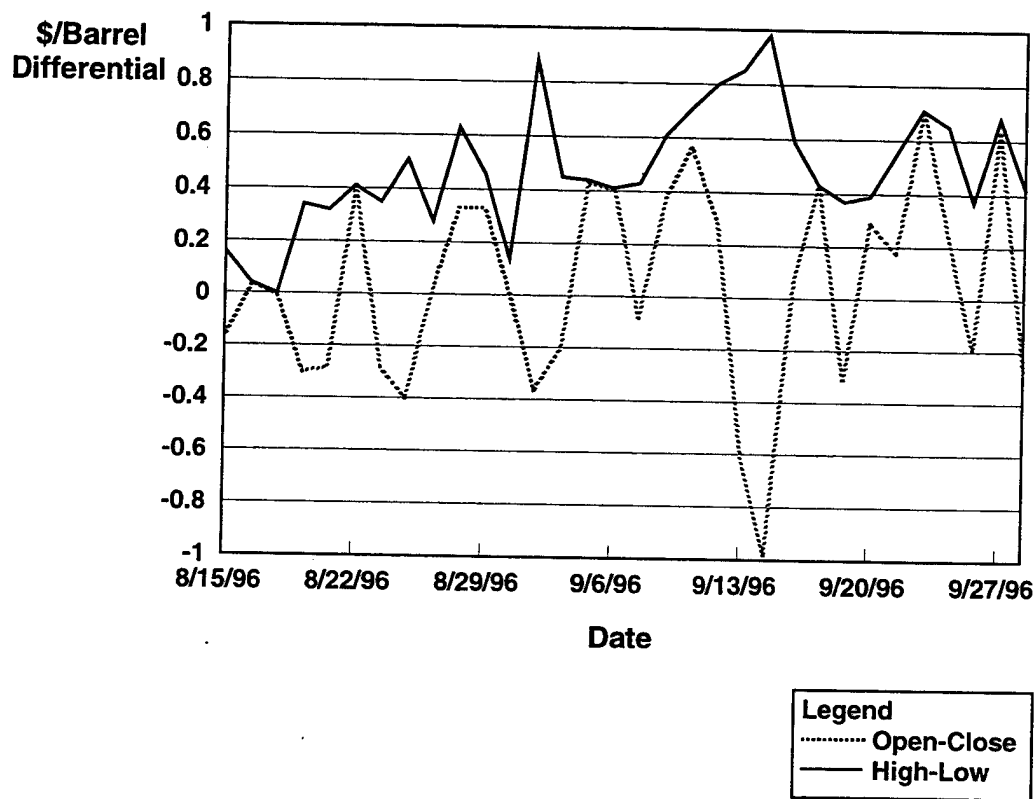
Figure C-3

Desert Strike: NYMEX:
Oil Spot and Future Patterns
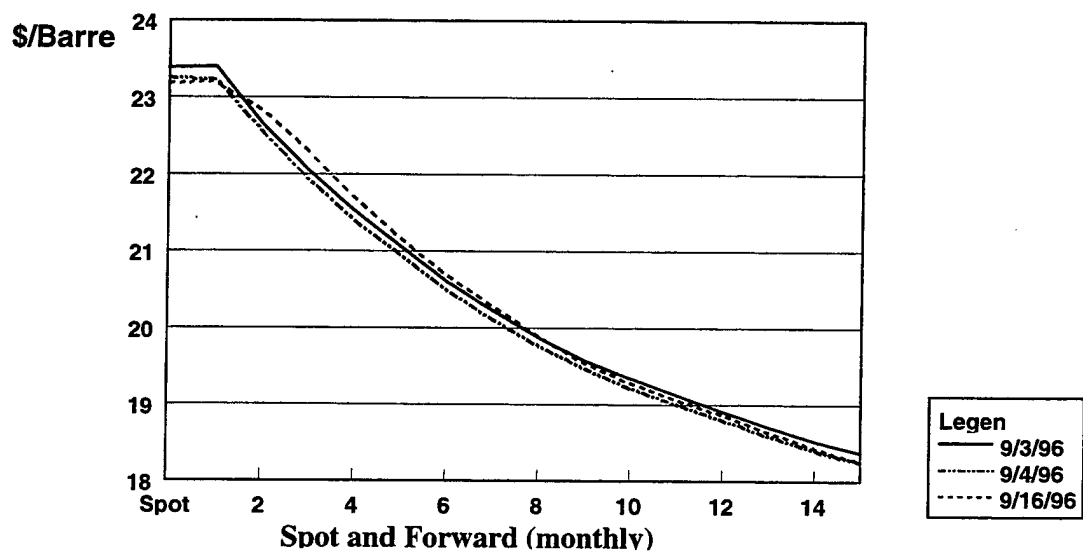
Figure C-4

Desert Strike:
Yen/Dollar Exchange Rate

Yen/Dollar

Date
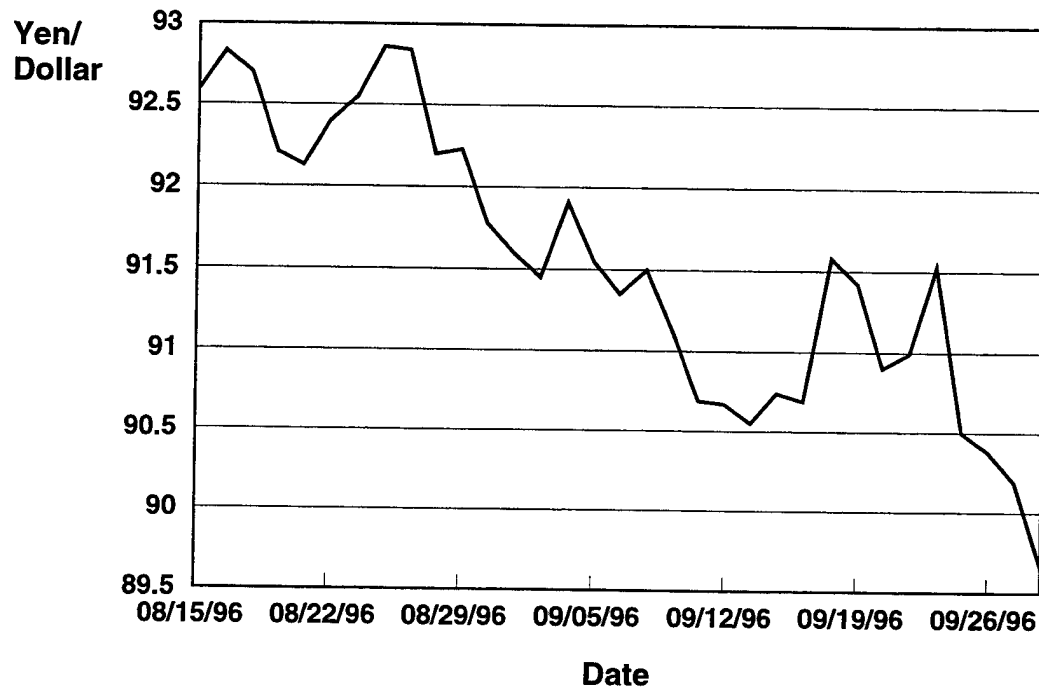
Figure C-5

Desert Strike: Change in
the Dollar/Yen Exchange Rate
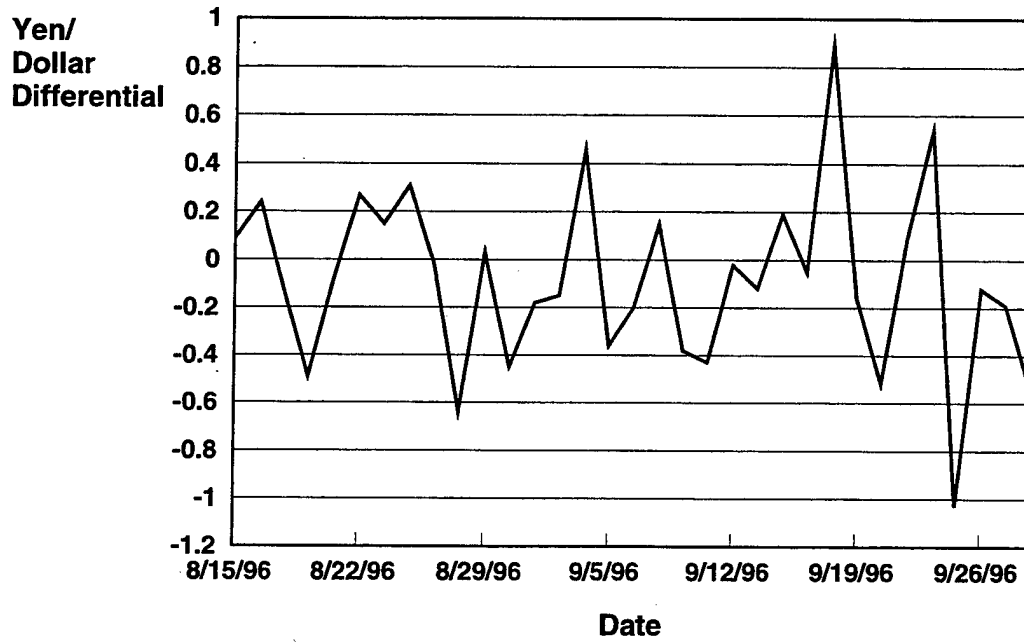
Figure C-6

Desert Strike: Yen/Dollar
Exchange Rate Daily Volatility
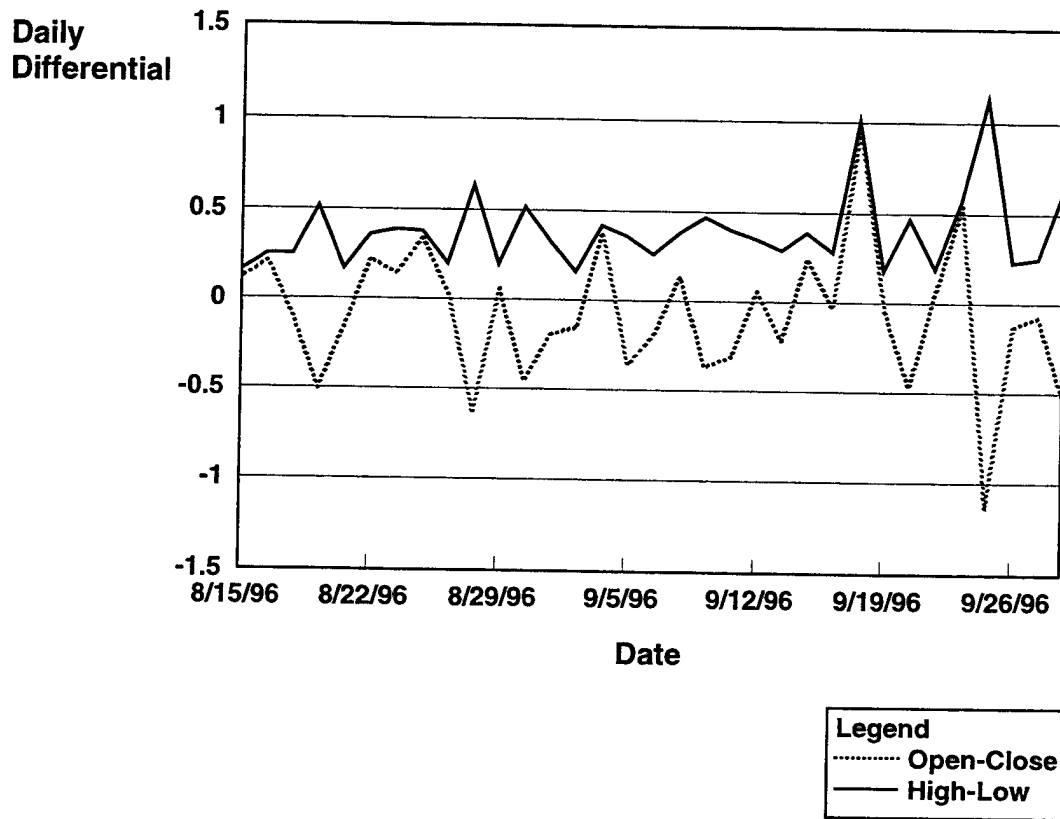
Notes: Open-Close is the opening price minus the closing price. High-Low is the daily price high minus the low price for that day.

Figure C-7

Desert Strike:
Yen/Dollar Forward Rates
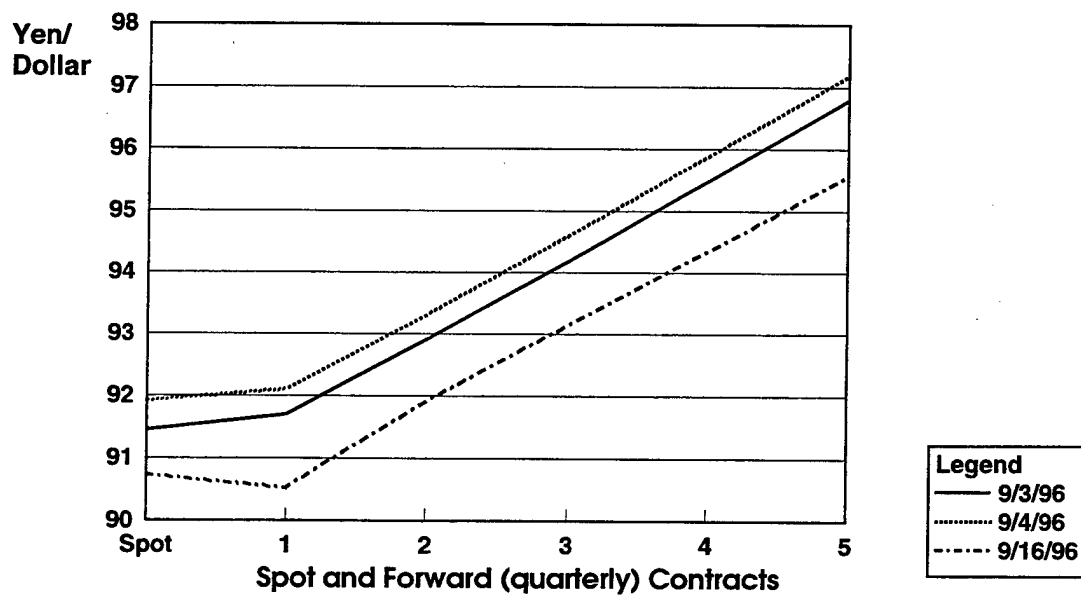
Appendix D

Operation Desert Fox: Assigned Event Scores

Table D-1

Event Analysis Variables

| Date	EVENTA	EVENTB
10/1/98	0	0
10/2/98	0	0
10/5/98	0	0
10/6/98	0	0
10/7/98	0	0
10/8/98	0	0
10/9/98	0	0
10/12/98	0	0
10/13/98	0	0
10/14/98	0	0
10/15/98	0	0
10/16/98	0	0
10/19/98	0	0
10/20/98	0	0
10/21/98	0	0
10/22/98	0	0
10/23/98	0	0
10/26/98	0	0
10/27/98	0	0
10/28/98	0	0
10/29/98	0	0
10/30/98	0	0
10/2/98	3	3
10/3/98	0	0
10/4/00	0	0
11/4/98	1	1
11/6/98	0	0
11/9/98	0	0

Notes: See Desert Fox timeline for a listing of the events.

Table D-2

Event Analysis Variables (contd)

Date	EVENTA	EVENTB
11/10/98	0	0
11/11/98	2	2
11/12/98	0	0
11/13/98	0	0
11/16/98	-3	-3
11/17/98	0	0
11/18/98	0	0
11/19/98	0	0
11/20/98	0	0
11/23/98	0	0
11/24/98	0	0
11/25/98	0	0
11/26/98	0	0
11/27/98	0	0
11/30/98	0	0
12/1/98	0	0
12/2/98	0	0
12/3/98	0	0
12/4/98	0	0
12/7/98	0	0
12/8/98	1	1
12/9/98	0	0
12/10/98	0	0

Notes: See Desert Fox Timeline for a listing of the events.

Table D-3

Event Analysis Variables (contd)

Date	EVENTA	EVENTB
12/11/98	0	0
12/14/98	0	0
12/15/98	0	0
12/16/98	0	0
12/17/98	3	-3
12/18/98	2	-2
12/21/98	-3	-3
12/22/98	0	0
12/23/98	0	0
12/24/98	0	0
12/28/98	0	0
12/29/98	0	0
12/30/98	0	0
12/31/98	0	0

The main difference between the event scoring in EVENTA and EVENTB is that the naval actions are given a minus sign in EVENTB (naval actions reduce uncertainty, thus lowering the risk premium on oil prices) as opposed to the assigned positive signs in EVENTA (naval actions indicate potential for conflict and disruption of oil supplies).

A number of events during Desert Fox occurred on the weekends. It was assumed here that the impact on markets would occur on the subsequent Monday.

10/31	Saturday	Listed as November 2
11/14	Saturday	Listed as November 16
12/19	Saturday	Listed as December 21
12/20	Saturday	Listed as December 21

Operation Desert Fox: Market Movements

Figure E-1

Operation Desert Fox: NYMEX Spot Oil Price

Operation Desert Fox: Change in the NYMEX Spot Oil Price
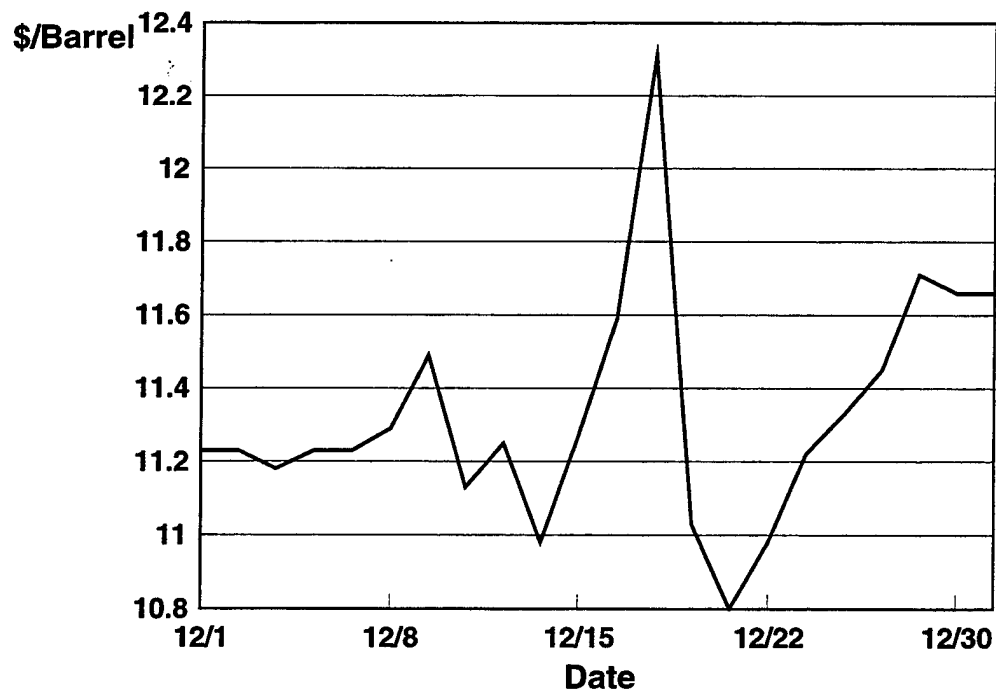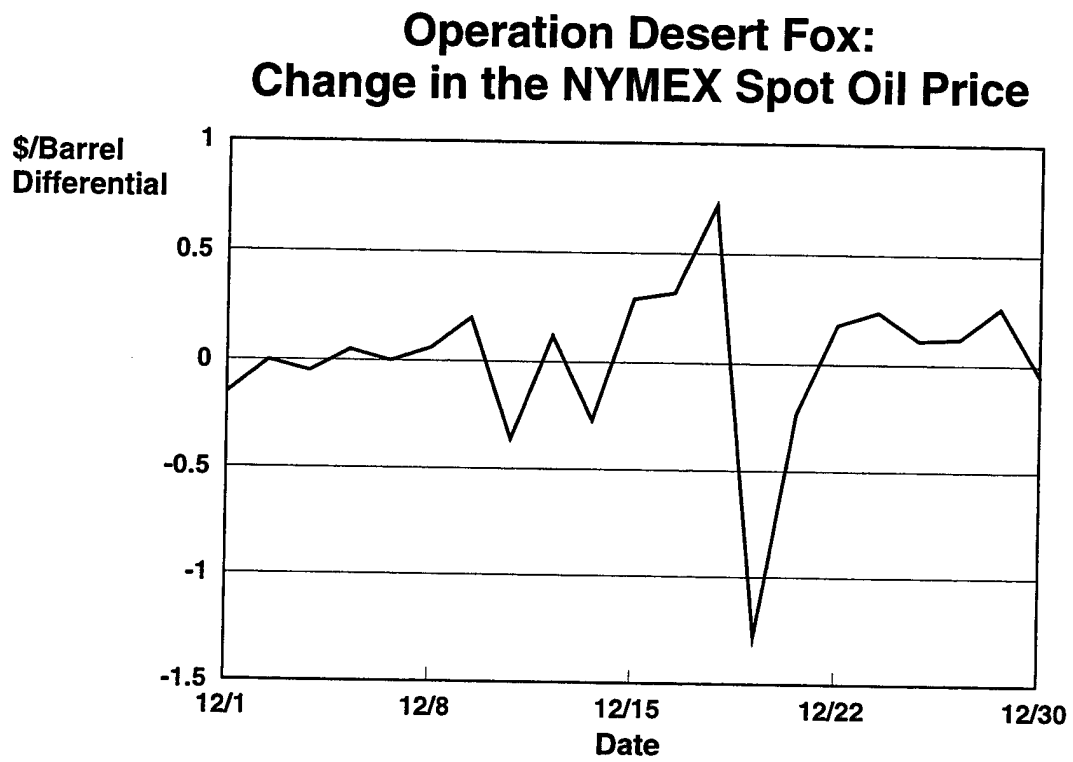
**Operation Desert Fox
NYMEX Oil Market Volatility**
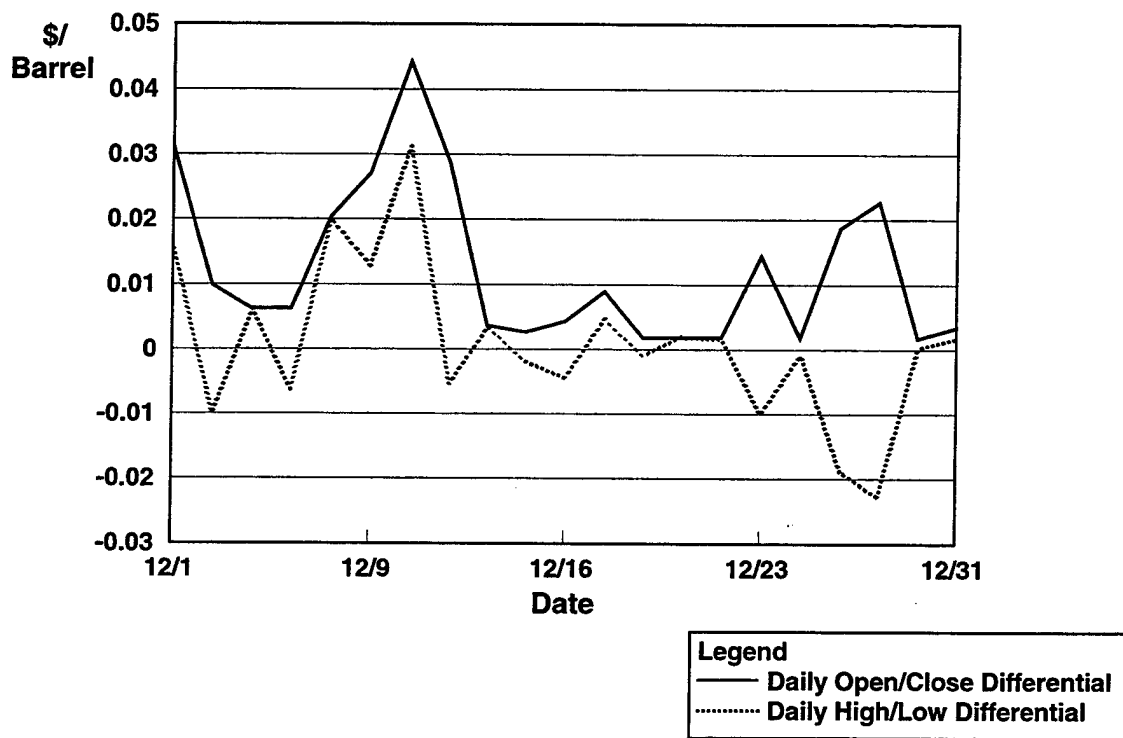
Notes: Open-Close is the opening price minus the closing price. High-Low is the daily price high minus the low price for that day.

Desert Strike:
NYMEX Spot and Futures

$/Barrel

X-axis: Spot and Forward (monthly) Contracts — values 5, 10, 15, 20 with "Spot"
Y-axis: 10 to 17

Legend
- ---·---·-- 1-Dec
- ———— 8-Dec
- ----- 16-Dec
- **————** 21-Dec

110
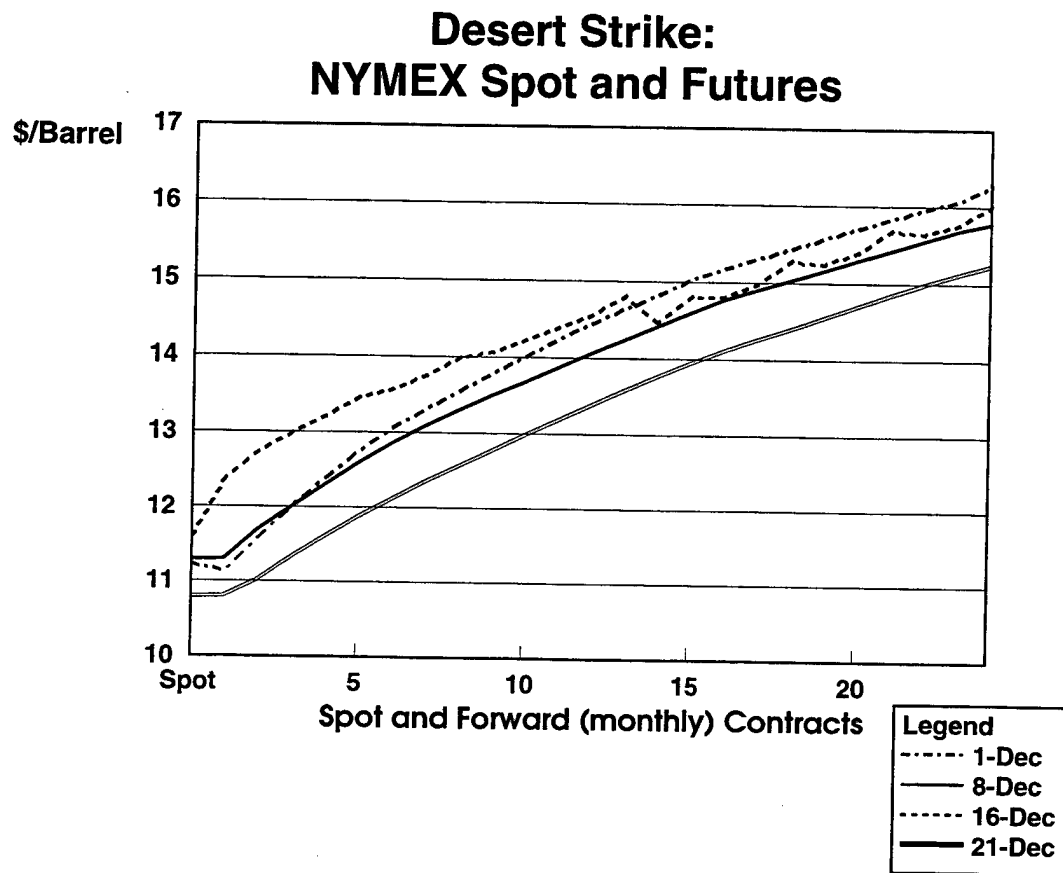
Operation Desert Fox: Yen/Dollar Exchange Rate

Operation Desert Fox
Change in the Yen/Dollar Exchange Rate

Operation Desert Fox
Spot/Forward Dollar/Yen Patterns

Legend
—— Spot-First Forward
·········· First-Second Forward

Desert Strike:
Yen/Dollar Futures

Yen/Dollar

Legend
— 12/1/98
--■-- 12/8/98
------ 12/16/98
— 12/22/98

Spot and Forward (quarterly) Contracts
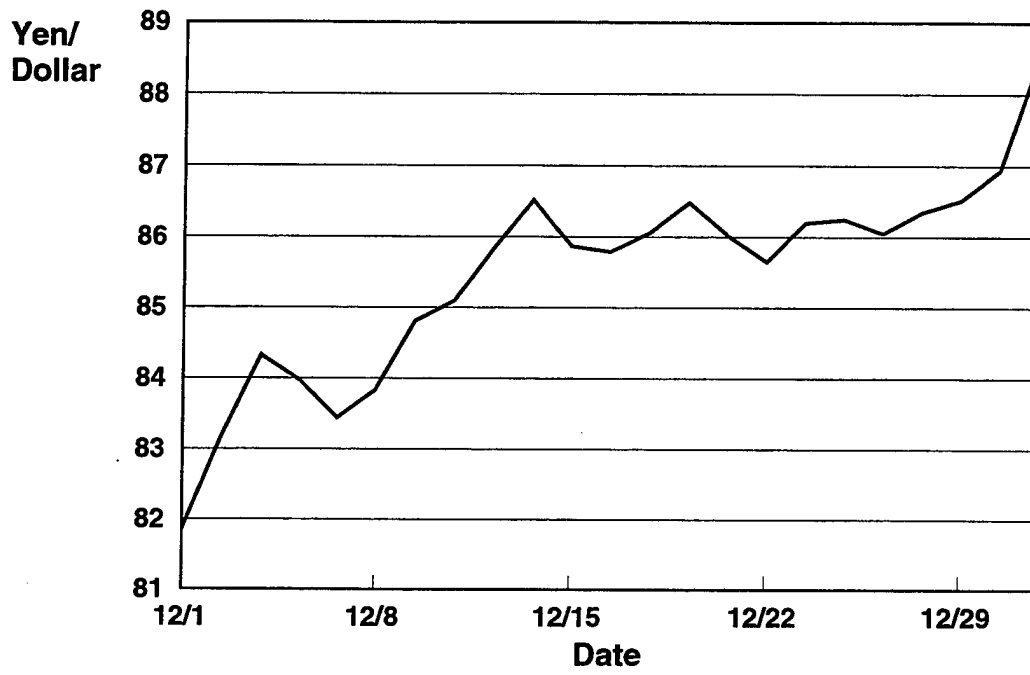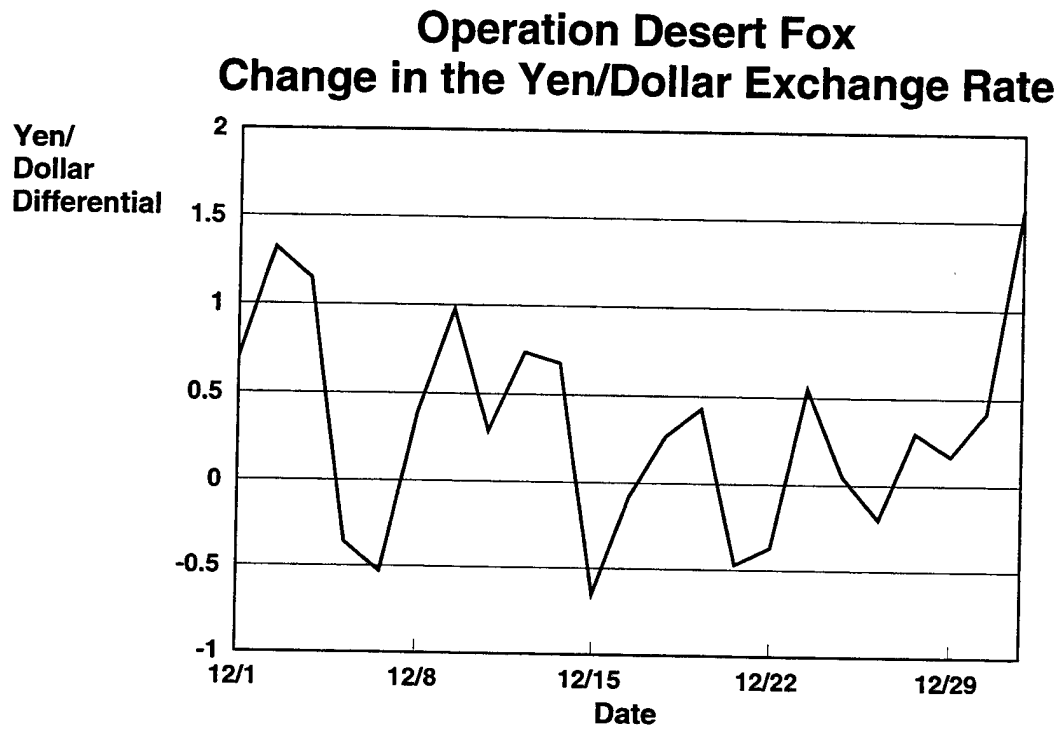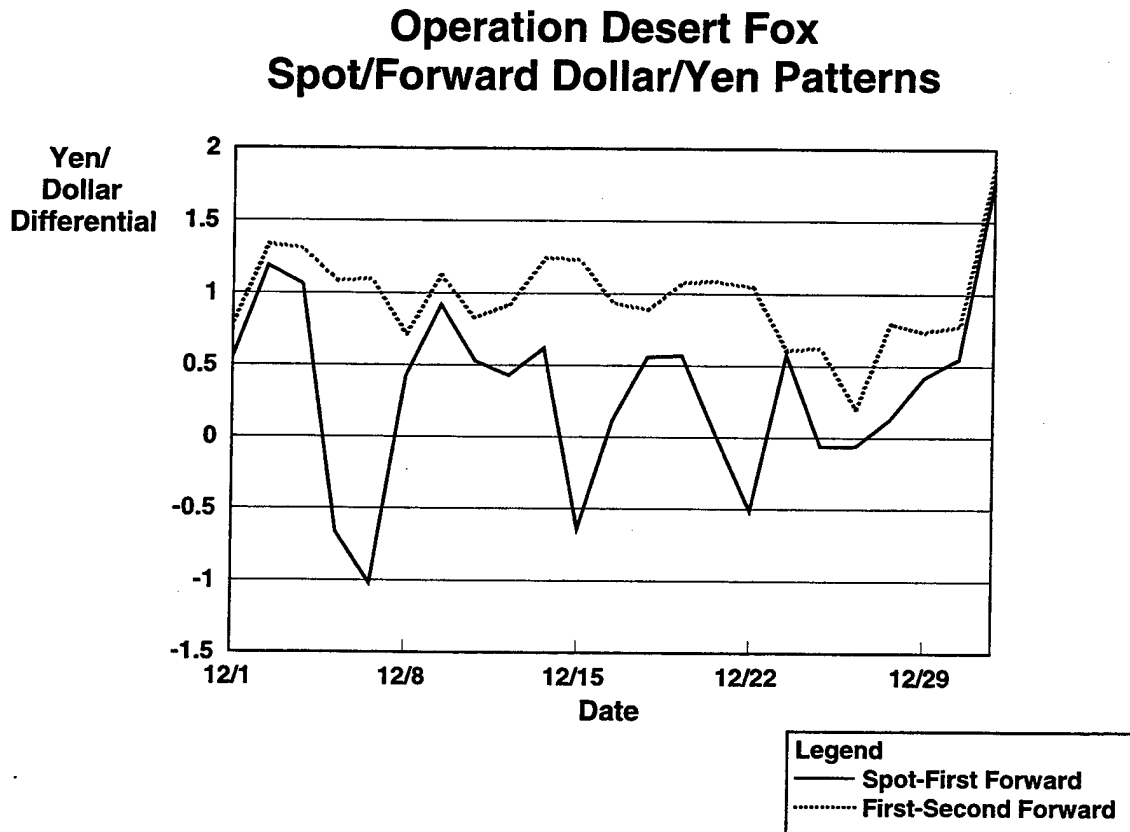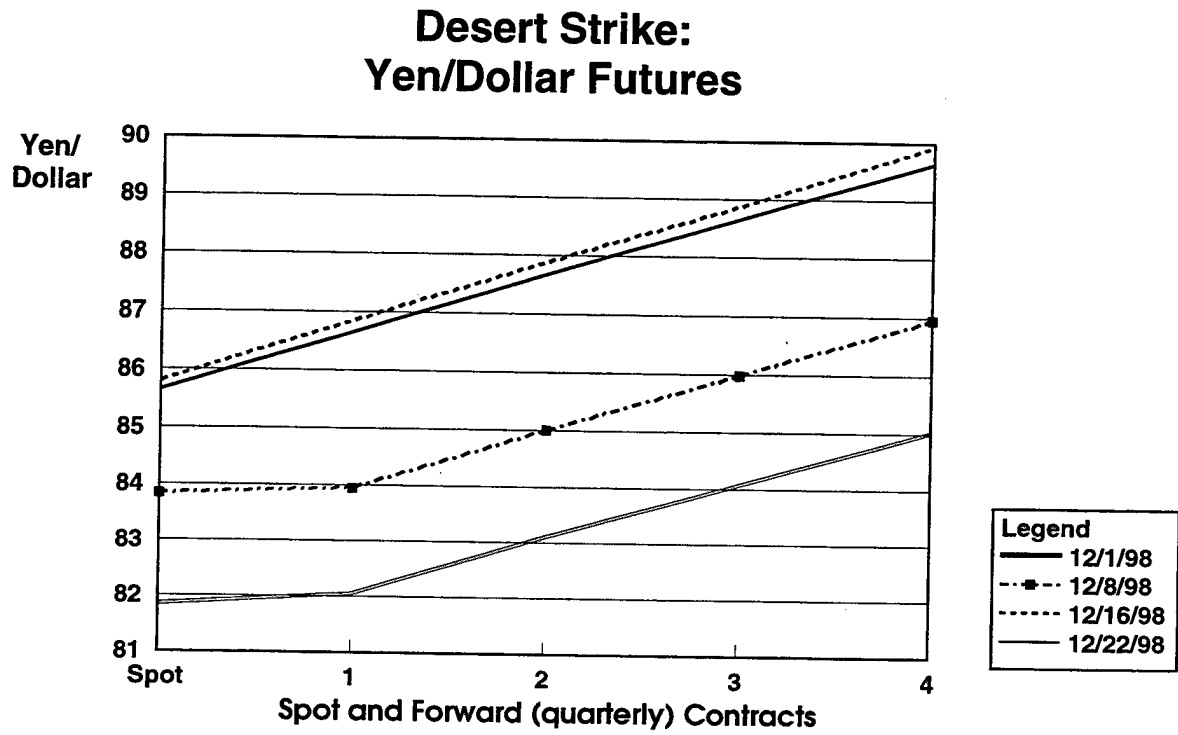
Appendix F

Libyan Operations (1986)

Table F-1

Assigned Event Analysis Values

DATE	EVENTA	EVENTB	EVENTC
1/2/86	0	0	0
1/3/86	0	0	0
1/6/86	0	0	0
1/7/86	1	-1	1
1/8/86	0	0	0
1/9/86	0	0	0
1/10/86	0	0	0
1/13/86	1	-1	1
1/14/86	0	0	0
1/15/86	2	-2	2
1/16/86	0	0	0
1/17/86	0	0	0
1/20/86	0	0	0
1/21/86	0	0	0
1/22/86	0	0	0
1/23/86	0	0	0
1/24/86	2	-2	2
1/27/86	1	-1	1
1/28/86	-2	-2	2
1/29/86	-2	-2	2
1/30/86	1	-1	1
1/31/86	-1	-1	1
2/3/86	-1	-1	1
2/4/86	0	0	0
2/5/86	0	0	0
2/6/86	0	0	0
2/7/86	0	0	0
2/10/86	0	0	0

Table F-2

Assigned Event Analysis Variables

DATE	EVENTA	EVENTB	EVENTC
2/11/86	-1	-1	1
2/12/86	3	-3	3
2/13/86	1	-1	1
2/14/86	1	-1	1
2/18/86	3	-3	3
2/19/86	0	0	0
2/20/86	0	0	0
2/21/86	0	0	0
2/24/86	0	0	0
2/25/86	0	0	0
2/26/86	0	0	0
2/27/86	0	0	0
2/28/86	0	0	0
3/3/86	0	0	0
3/4/86	0	0	0
3/5/86	0	0	0
3/6/86	0	0	0
3/7/86	0	0	0
3/10/86	0	0	0
3/11/86	0	0	0
3/12/86	0	0	0
3/13/86	0	0	0
3/14/86	0	0	0
3/17/86	0	0	0
3/18/86	0	0	0
3/19/86	0	0	0
3/20/86	0	0	0

Table F-3

Assigned Event Analysis Variables

DATE	EVENTA	EVENTB	EVENTC
3/21/86	0	0	0
3/24/86	3	-3	3
3/25/86	1	-1	1
3/26/86	1	-1	1
3/27/86	2	-2	2
3/31/86	0	0	0
4/1/86	0	0	0
4/2/86	0	0	0
4/3/86	0	0	0
4/4/86	0	0	0
4/7/86	2	2	2
4/8/86	0	0	0
4/9/86	2	1	2
4/10/86	2	1	2
4/11/86	1	-1	1
4/14/86	2	0	2
4/15/86	3	-3	3
4/16/86	-1	-1	1
4/17/86	0	0	0
4/18/86	0	0	0
4/21/86	0	0	0
4/22/86	0	0	0
4/23/86	0	0	0
4/24/86	0	0	0
4/25/86	0	0	0
4/28/86	0	0	0
4/29/86	0	0	0
4/30/86	0	0	0

Table F-4

Assigned Event Analysis Variables

DATE	EVENTA	EVENTB	EVENTC
5/1/86	0	0	0
5/2/86	0	0	0
5/5/86	0	0	0
5/6/86	0	0	0
5/7/86	0	0	0
5/8/86	0	0	0
5/9/86	0	0	0
5/12/86	0	0	0
5/13/86	0	0	0
5/14/86	0	0	0
5/15/86	0	0	0
5/16/86	0	0	0
5/19/86	0	0	0
5/20/86	0	0	0
5/21/86	0	0	0
5/22/86	0	0	0
5/23/86	0	0	0
5/27/86	0	0	0
5/28/86	0	0	0
5/29/86	0	0	0
5/30/86	0	0	0

Notes: See Libyan timeline for a listing of the events. EVENTA assumes that naval actions cause increased uncertainty in the oil markets resulting in price increases, with other events' signs determined by their likely impact on oil prices. EVENTB assumes that naval actions result in reduced uncertainty in the oil markets and price declines, with other events' signs determined by their likely impact on oil markets. EVENTC assumes that all events are interpreted by the oil markets as creating instability and increased uncertainty.

Relevant Market Movements During the Libyan Operations (1986)

Figure G-1

Libyan Operations: Attain Document I NYMEX Spot Oil Price
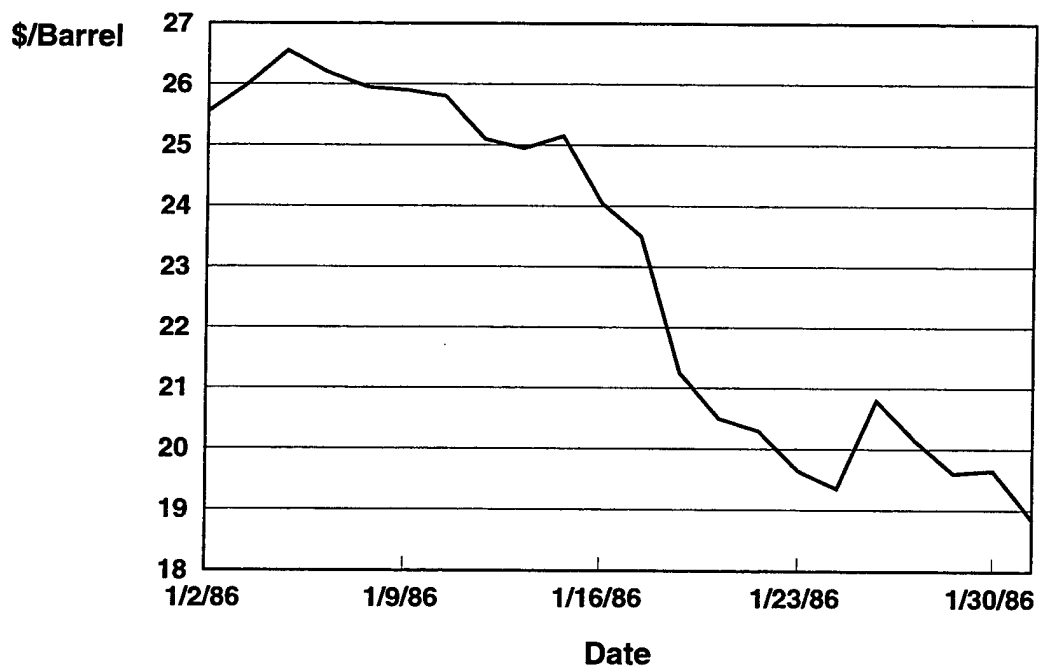
Figure G-2

Libyan Operations: Attain Document I
NYMEX Spot Oil Daily Change

120
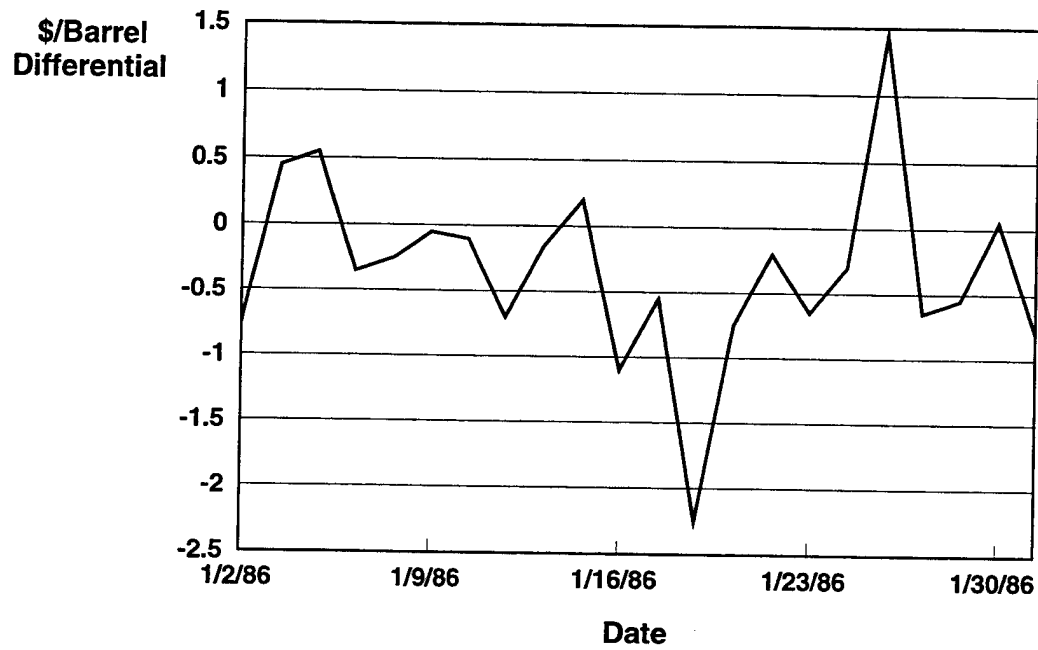
Libyan Operations: Attain Document I
NYMEX Spot Price - First Forward Contract
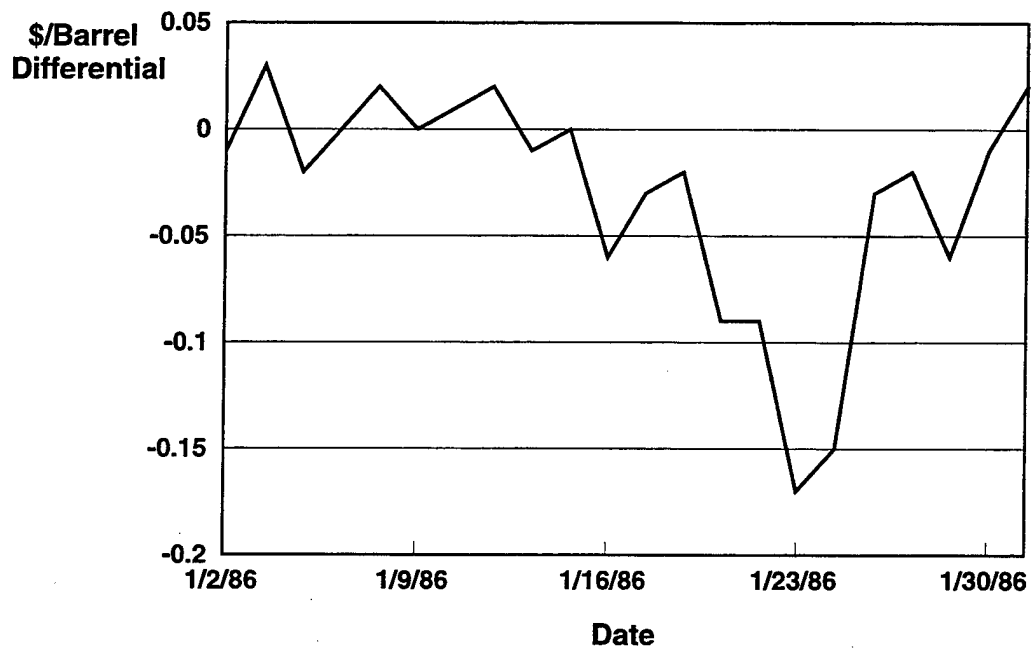
Libyan Operations: NYMEX Oil
First-Second Forward Contract
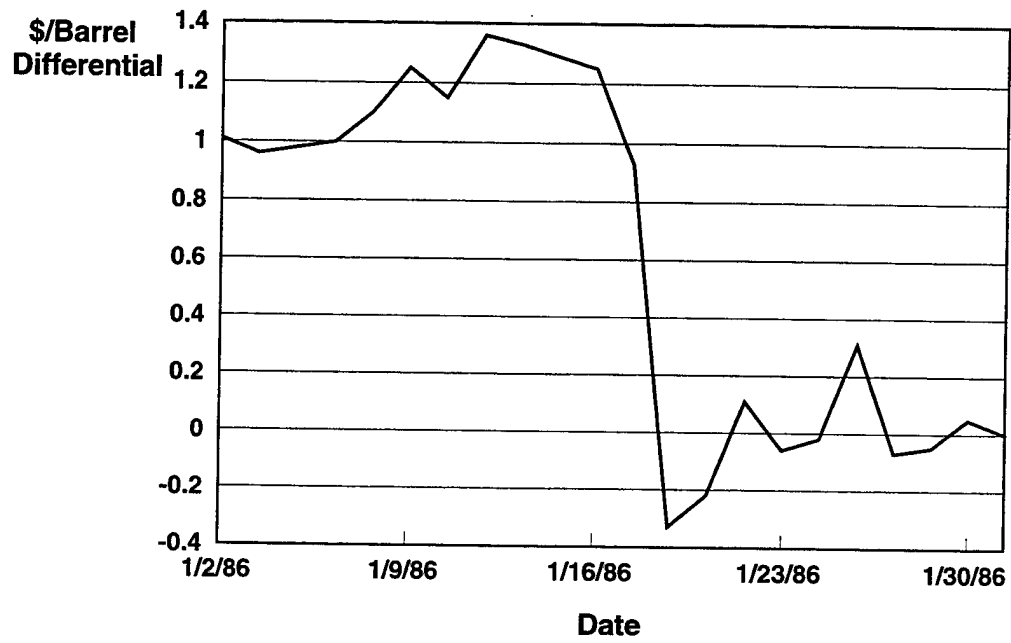
Libian Operations: Attain Document I
NYMEX: Spot and Forward Prices

$/Barrel

Forward Contracts (months)

Legend
- - - 15-Jan
—— 24-Jan
····■···· 27-Jan
- - - - 30-Jan

Libyan Operations: Attain Document I
NYSE Composite Index

Libyan Operations: Attain Document I
Change in the NYSE Composite Index

Libyan Operations: Attain Document I
NYSE Daily Volatility

Appendix H

Notes on Maritime Insurance Rates

This initiative was to see if commercial maritime insurance underwriters assess a war risk surcharge on vessels operating in or around areas of increased tension or conflict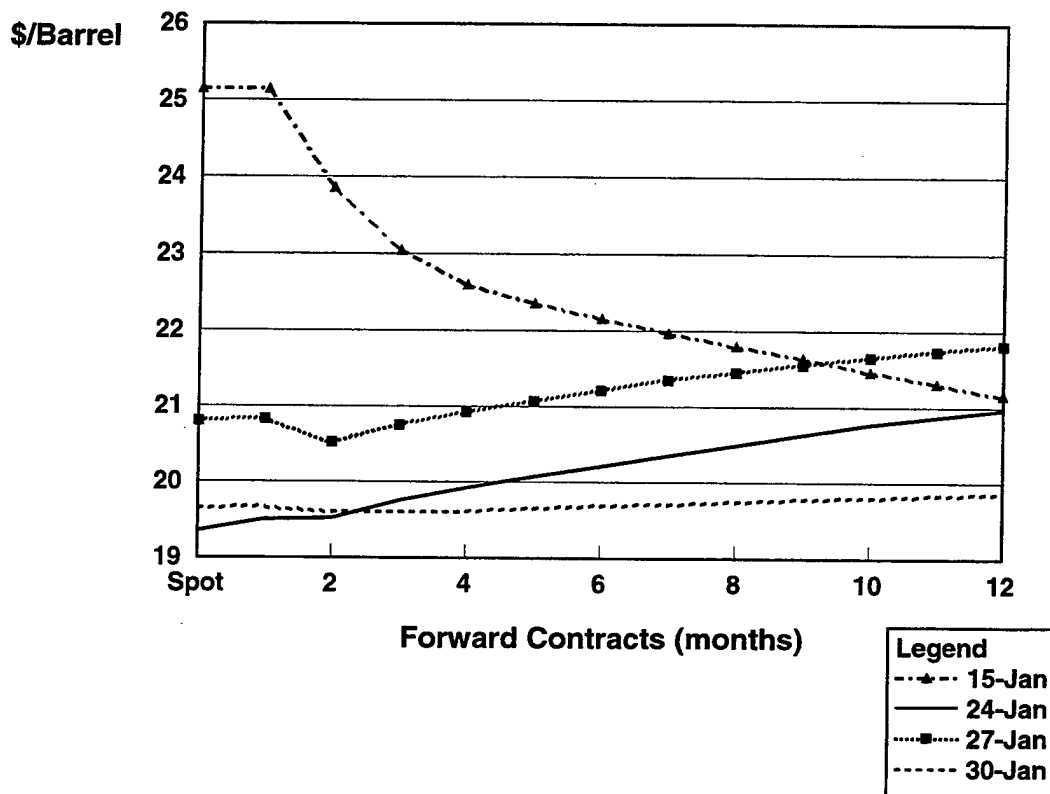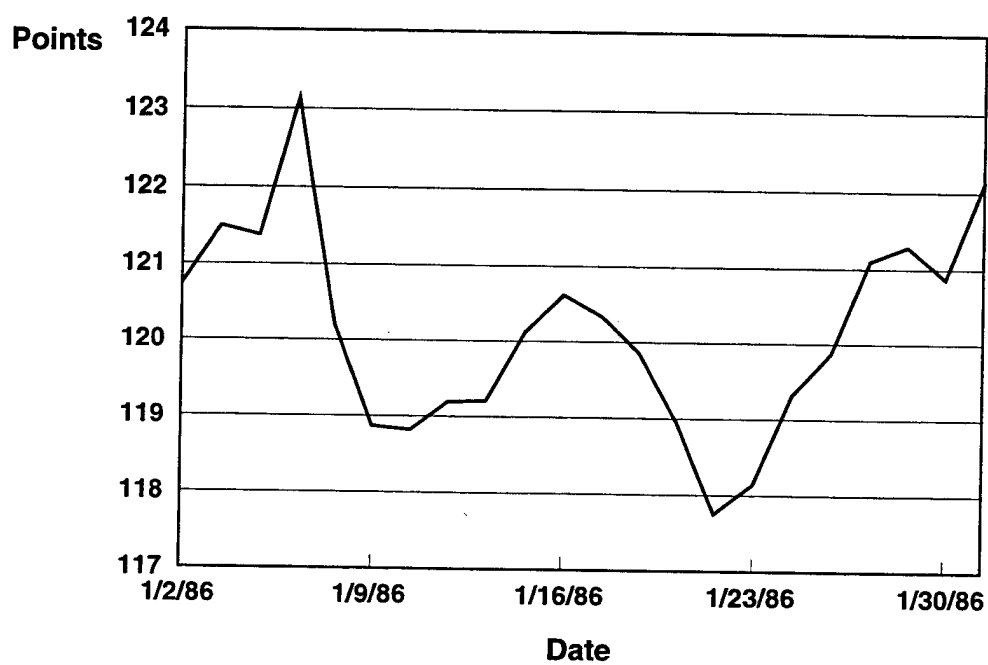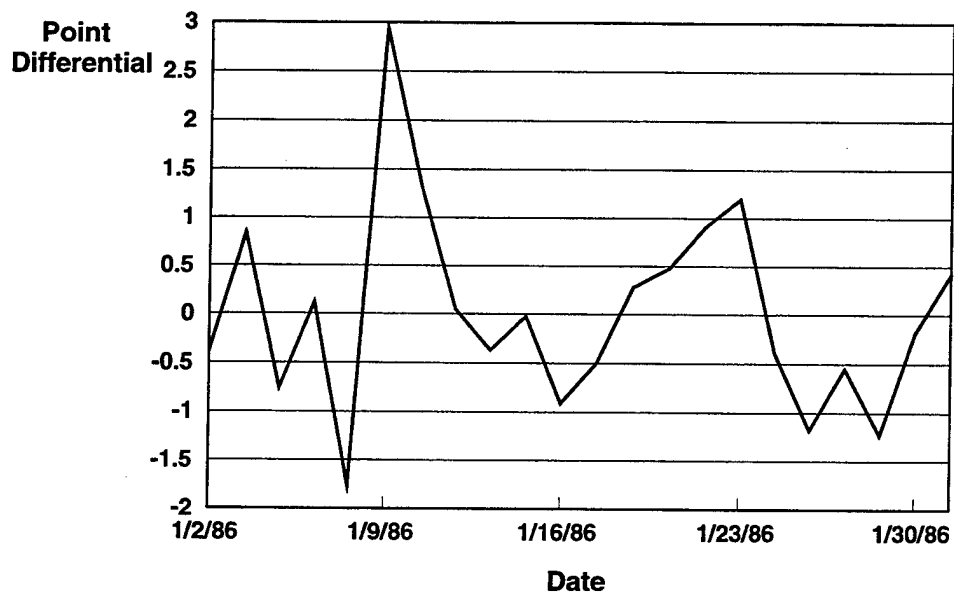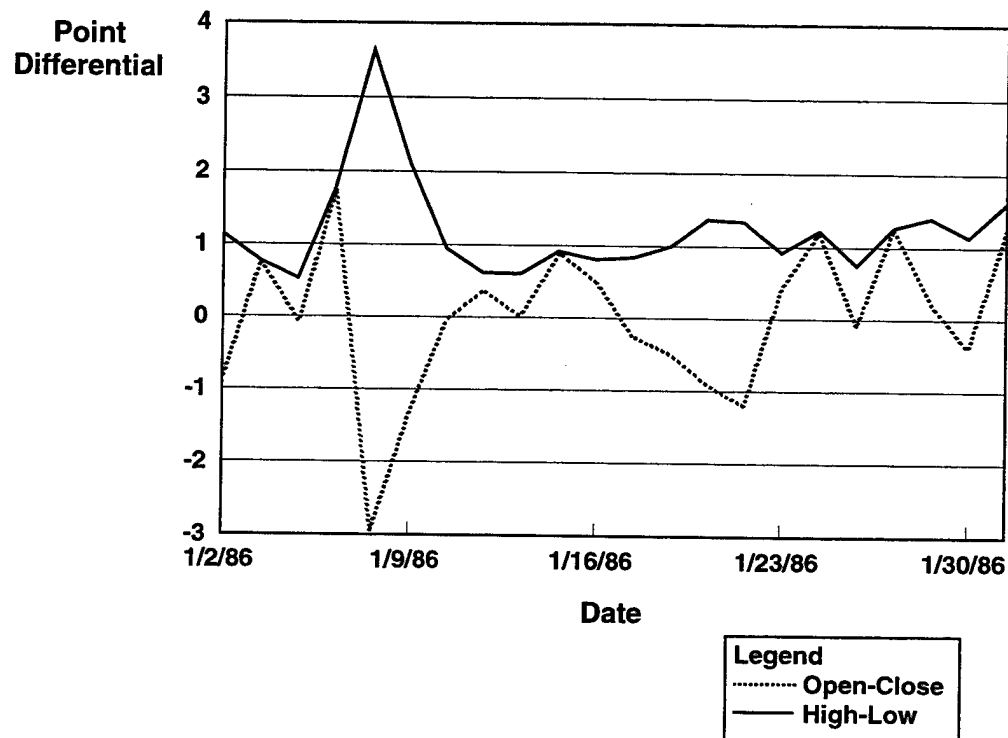. If there is such a surcharge and if historical data on its magnitude, the vessels effected, and the dates for which the surcharge was applied could be obtained, we could then test hypotheses about whether naval actions have any impact on maritime insurance rates.

Research was conducted to determine if the maritime insurance industry alteres maritime insurance rates on commercial vessels when commercial vessels are expected to operate in areas considered by the maritime industry to be at increased risk. . Eventually, the identification of a War Risk Surcharge was provided by Ms. Kathy Brennan, Client Manager, Marsh Canada Limited. It was further determined that the war risk surcharge (WRS) is set by the War Risk Rating Committee (WRRC) at the Institute of London Underwriters. However, questions concerning the WRRC and WRS addressed to Mr. Neil Smith, Secretary of the WWRC, have not been answered. The researcher also requested historical data on when the WRS was added to and eliminated from maritime insurance rates. Nine specific events that resulted in the presence of US naval forces were provided to Mr. Smith in order to determine if a correlation between the US naval presence and WRS existed. The dates and events were:

1. 18 Aug 1981 – 21 Aug 1981 (Libya)
2. 13 Jan 1986 – 15 Apr 1986 (Libya)
3. 1 Oct 1986 – 31 Mar 1987 (Tanker Wars, Persian Gulf)
4. 1 Jul 1990 – 31 Mar 1991 (Operation Desert Storm, Persian Gulf)
5. 12 Jul 1994 – 15 Oct 1994 (Operation Restore Democracy, Haiti)
6. 1 Sep 1994 – 30 Nov 1994 (Kuwaiti Border Incident)
7. 1 May 1995 – 31 Dec 1996 (Taiwan Strait Crisis)
8. 2 Sep 1996 – 3 Sep 1996 (Operation Desert Strike, Persian Gulf)
9. 1 Sep 1998 – 31 Jan 1999 (Operation Desert Fox, Persian Gulf)

No data has been provided by Mr. Smith (Neil Smith, Institute of London Underwriters, London England; e-mail: neil.smith@lloydsus.co.uk and lua@lua.e-market.net.uk; phone: 011-44-171-327-3333). Thus, for the present study at least, it was not possible to determine if naval crisis response has any impact on maritime shipping insurance rates.

127

APPENDIX I

Notes on Piracy

While the main thrust of the current study was focused on assessing the economic benefits derived from the four incidents of major naval action, the possibility of economic benefits derived from anti-piracy originating from forward deployed naval forces was also examined.

Several masters theses at the Naval Postgraduate School have looked at one aspect or another of this issue. These theses are:

- M. Farley, "International and Regional Trends in Maritime Piracy, 1989-1993," December 1993.

- C. Cobb, "Combating Maritime Piracy," December 1994.

- M. Lumpin, "Microviolence at Sea, 1975-1995: A Data Analysis," December 1995.

- William Sutton, "Naval Special Warfare: A Long-Range View," pending 2000.

While each thesis focuses on a different facet of piracy, they all convey the notion that anti-piracy may not be an area the United States Navy wants to become involved with.

The logic is as follows. Pirates seem to avoid targeting US vessels because they know the US Navy will respond. Currently, piracy is not a problem in US territorial wasters. Attacks on US vessels overseas have only occurred in situations where the odds of success were heavily stacked in the pirate's favor. The regions with high incidents of piracy are those providing pirates with a quick escape route, allowing them to strike and then quickly melt back into the coastal population.

One major impediment to the Navy being involved in anti-piracy are the issues surrounding sovereignty. International law dictates that each nation is expected to police its own territorial waters.

Sovereignty aside, there is no doubt that the US navy could get involved in maritime anti-piracy. The Navy's capability has been demonstrated repeatedly during the drug war. It seems to be more a question of should the U.S. Navy get involved? At this time the consensus (Oxford Analytica, "Problematic Piracy," April 5, 2000) appears to be that the costs are significantly greater than any potential benefits to be derived from that activity.

The other aspect of this is that the Asian countries themselves are coming to the realization that they must increase their own anti-piracy efforts. In an interesting development, Asian nations for the first time since World War II are considering a Japanese security role in the Region. Japan has proposed a regional coast guard to combat piracy in the Strait of Malacca and Singapore, as well as in the South China Sea (Mark Valencia, "Joining Up with Japan to Patrol Asian Waters," International Herald Tribune, April 28, 2000).

In promoting the anti-piracy program, Japan wants to reassert its waning influence in the region as a counterbalance to China. Tokyo also sees the move as a way of delicately

distinguishing itself and its approach from that of the United States. As Valencia notes, the initiative can be viewed as part of a broader strategy developed at Japan's National Institute of Defense Studies. Such a strategy envisages a Japan-led international Ocean Peacekeeping Force, which would be primarily concerned with activities that are necessary to fulfill obligations under the 1982 UN Convention on the Law of the Sea to maintain maritime order and prevent armed conflict at sea.

Another solution (Indira Lakshmanan, "Trouble in South China Sea: Pirates Dodge Navy Gunboats to Steal, Kidnap and Melt Away," San Jose Mercury-News, September 10, 2000) has been the entrance of private security companies. Sensing a niche, security companies have cropped up in Britain, the United States, Hong Kong, and Australia, providing former soldiers to defend ships and to search for and perhaps recover, missing vessels. The services are controversial because of fears that having armed mercenaries abroad could escalate the violence.

APPENDIX J

Data Sources

The data used in this study comes from three main sources:

CRB Historical Data

This source provided the raw data for the various markets used in the analysis. The spot data is daily while the future contracts are either monthly (oil) or quarterly (foreign exchange). The series used in the analysis included
:

Oil
NYMEX Oil (spot and future)
Brent Oil (spot and future)

Commodities
CRB Commodity Index (spot and future)
Goldman-Sachs Commodity Index (spot and future)

Foreign Exchange
Dollar Index (spot and future)
Dollar/Yen Exchange Rate (spot and future)
Dollar/Deutsche Mark Rate (spot and future)
Dollar/British Pound Rate (spot and future)
Dollar/French Franc Rate (spot and future)

Share Markets
New York Stock Exchange Composite Index (daily)
S&P-100 Index (daily)
FTSE-100 Index (daily)
Nikkei-225 Index (daily)
Hang Seng Index (daily)

OECD MEI Databases

This is one of the standard sources of data on the United States economy. In this study we used primarily the macroeconomic series, which is recorded on a quarterly basis. Key series used were Gross Domestic Product (GDP), various types of investment appearing in the National Accounts, and Government Consumption, also appearing in the National Accounts. These series are in constant 1995 prices.

Events

The events associated with each case were compiled from newspaper accounts of the period. They were obtained from Lexus/Nexus and were primarily from the New York Times, the Los Angeles Times and CNN. Oil market information is from the Financial Times as compiled by Lexus/Nexus

Appendix K

References

Corzine, Robert (1996), "Delay to Iraqi Sales Boosts Oil Prices," <u>Financial Times</u>, September 3, 1996, p. 5.

Corzine, Robert (1996), "Oil Price Yo-Yos as Traders Digest News From Iraq," <u>Financial Times</u>, September 5, 1996, p. 3.

Corzine, Robert, (1998), "Slide in Crude Surprises All," <u>Financial Times</u>, December 24, 1998, p. 20.

Corzine, Robert (1999),"Prospects for Firmer Prices Uncertain," <u>Financial Times</u>, January 29, p. 3.

Gabilon, J (1995), "Analyzing the Forward Price Curve," in <u>Managing Energy Price Risk</u>, London: Risk Publications, ENRON Capital & Trade Resources.

Gwertzman, Bernard, (1986), "U.S. Oil Companies May be Exempted from Libya Curbs," <u>New York Times</u>, January 31, p. 1.

Gwertzman, Bernard, (1986), "State Dep. Official Warns Libyans," <u>New York Times</u>, January 28, p. 8.

Gwertzman, Benard (1986), "U.S. Navy Starting Flights off Libya,' <u>New York Times</u>, January 24, p. 8.

Kurth, James (2000), "American Strategy in the Global Era," <u>Naval War College Review</u> Winter 2000.

Looney, Robert (2000), "Saudi Arabia: Measures of Transition From a Rentier State," <u>Conference on Iran, Iraq, and the Arab Gulf States</u>, UCLA, May 3-4.

Looney, Robert and P.C. Frederiksen (2000), "The Effect of Declining Military Influence on Defense Budgets in Latin America" <u>Armed Forces and Society</u> 26:3 437-450.

Miller, Judith (1986), "Oil Officials are Said to Leave Libya," <u>New York Times</u>, January 30, p. 1.

Miller, Judith (1986), "Qaddafi Sails off to Confront U.S. Warships," <u>New York Times</u>, January 26, p. 1.

Miller, Judith (1986), "Qaddafi Says he has Called Full Alert" <u>New York Times</u>, January 25, p. 4.

Naval Postgraduate School (1997), <u>Forward Engagement Requirements for U.S. Naval Forces: New Analytical Approaches</u>, Report for the Deputy Chief of Naval Operations (N-8), July 23.

Oxford Analytica (2000), "Problematic Piracy," April 5.

Pesaran, M.H. and Bahram Pesaran (1997), <u>Working with Microfit 4.0: Interactive Econometric Analysis</u> (Cambridge, UK: Camfit Data).

Porch, Douglas (1999), "The Taiwan Strait Crisis of 1996: Strategic Implications for the United States" <u>Naval War College Review</u>, Summer, pp 15-48.

Sims, C (1980), "Large Scale Econometric Models," <u>Econometrica</u> 48:1, 1049.

Solman, Paul (1998), "Oil Prices Slipped Yesterday in Spite of Continued Military Action in the Gulf," Financial <u>Times</u>, December 18, p. 34.

Solman, Paul (1998), "Oil Prices Continue to Drift Downward," <u>Financial Times</u>, December 11, p. 30

Solman, Paul (1999), "Outlook for Oil Remains Uncertain," <u>Financial Times</u>, January 2, p. 8

Suro, Robert (1986), "Libya Makes Offer to Stem Terrorism," <u>New York Times</u>, January 29, p. 16.

System Planning Corporation, (1996), <u>Political and Economic Implications of Global Naval Presence, System Planning Corporation</u>, Report for Office of the Deputy Chief of Naval Operations (N81), September 30.

Verleger, Philip (2000), "Third Oil Shock: Real or Imaginary? Consequences and Policy Alternatives" Washington: <u>Institute for International Economics</u>, April.

Wolf, Martin (2000), "The New Economy Gets a Shock," <u>Financial Times</u>, October 17.

Yergin, Daniel (2000), "What Energy Crisis?" <u>Wall Street Journal</u>, October 17

"Flying High," <u>Financial Times</u>, September 3, 1996, p. 1

"Navy Leaders Call for Boost in Budget Topline," <u>Defense Daily</u> June 21, 2000

"Oil Prices Advance After U.N. Delays Iraq's Entry in the Market," <u>New York Times</u>, September 3, 1996, p. D-6;

DISTRIBUTION LIST

1. Research Office (Code 09)...1
   Naval Postgraduate School
   Monterey, CA 93943-5000

2. Dudley Knox Library (Code 013) 2
   Naval Postgraduate School
   Monterey, CA 93943-5002

3. Defense Technical Information Center 2
   8725 John J. Kingman Rd., STE 0944
   Ft. Belvoir, VA 22060-6218

4. Therese Bilodeau (Editorial Assistant)..1
   Dept of Operations Research
   Naval Postgraduate School
   Monterey, CA 93943-5000

5. Prof. David A. Schrady (Code OR/So) 10
   Dept of Operations Research
   Naval Postgraduate School
   Monterey, CA 93943-5000

6. Prof. Robert Looney (Code NS)..1
   Dept of Operations Research
   Naval Postgraduate School
   Monterey, CA 93943-5000

7. RADM Joseph A. Sestak..1
   Office of the Chief of Naval Operations, N8C
   2000 Navy Pentagon
   Washington, DC 20350-2000

8. RADM John T. Byrd...1
   Office of the Chief of Naval Operations, N3/5B
   2000 Navy Pentagon
   Washington, DC 20350-2000

9. Captain Sam J. Tangredi 1
   Senior Military Fellow
   NDU QDR `01 Working Group
   National Defense University
   Marshall Hall, Room 314
   Fort McNair
   Washington, DC 20319

10. Mr. Bruce Powers 1
    Office of the Chief of Naval Operations
    N816
    2000 Navy Pentagon
    Washington, DC   20350-2000

11. LCDR John Ruck 6
    Office of the Chief of Naval Operations
    2000 Navy Pentagon
    Washington, DC   20350-2000

12. CDR David Spain 1
    National Security Affairs
    Naval Postgraduate School
    Monterey, CA   93943-5000

13. Professor James Wirtz 1
    National Security Affairs
    Naval Postgraduate School
    Monterey, CA   93943-5000